JOURNAL OF GAS LIGHTING, WATER SUPPLY, &c.

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EDITORIAL NOTES.

London Gas Companies' Working Last Year.

IN another part of the "JOURNAL" will be found a table giving the financial results of the working of the three London Gas Companies during the year ended the 31st of December, with all the items of revenue and expenditure worked out at per 1000 cubic feet of gas sold. For the sake of comparison, similar particulars for the preceding year are given. It will probably be remembered that, by the courtesy of Mr. F. J. Bradfield, the Secretary of the Commercial Gas Company, we were enabled to give in the "JOURNAL" for the 5th of March the analyses he had prepared (in continuation of his previous similar compilations) of the half-yearly accounts of the three London and four Suburban Gas Companies for the year 1911, together with a table showing the increases or decreases which had taken place in the second half of the year, as compared with the corresponding period of 1910. In these tables, the accounts were dealt with in such detail as to render unnecessary the analysis which has for many years appeared in our pages. It was thought, however, that it might be useful to present the capital raised and the totals of the various items of revenue and expenditure of the London Companies. It will be seen that the capital (including premiums) engaged in the supply of gas on Dec. 31 amounted to £40,142,763, that the total income was £7,320,595, the expenditure £5,382,683, and the gross profit £1,937,912. The capital was slightly less and the other totals rather more than those for the preceding year. The gross profit was £4 16s. 6d. per cent. on the capital and borrowed money, and £39 5s. 10d. on the total gas-rental. The figures for 1910 were £4 16s. 3d. and £38 14s. 8d. On the basis of each 1000 cubic feet of gas sold, the figures are: Capital, 19s. 4·8d.; income, 3s. 6·46d.; expenditure, 2s. 7·22d.; and profit, 11·24d. Those for 1910 were, respectively, 19s. 7·82d., 3s. 6·11d., 2s. 6·76d., and 11·35d.

The following table shows the carbonizing results of the three Companies, so far as they relate to the manufacture of gas from solid raw material only; and a noteworthy feature is the further increase in the quantity of gas produced in the case of each Company. The mean make per ton last year was 12,047 cubic feet, compared with 11,828 and 11,405 cubic feet in the two preceding years.

TABLE *showing the Residuals Produced and the Gas Made per Ton of Coal by the Metropolitan Gas Companies in the Year* 1911.

Name of Company.	Coke.	Breeze.	Tar.	Am. Liq.	Gas.
	Cwt.	Bushels.	Gallons.	Gallons.	Cub. Ft.
GASLIGHT AND COKE .	12·66	4·91	9·60	35·72	11,886
SOUTH METROPOLITAN .	12·36	4·39	9·73	40·00	12,215
COMMERCIAL	12·50	4·92	11·88	38·24	12,638
Mean per Ton . .	12·55	4·73	9·79	37·37	12,047

The Gas-Fire at Home and Abroad.

THE distinguished General Manager in Berlin of the Imperial Continental Gas Association (Mr. E. Körting) has done yet another good service to the gas industry by drawing attention to the comparative merits of the types of gas-fire which are most in vogue in this country and in Germany. He was provided, through the good offices of Mr. Alexander Wilson, of Glasgow, with a modern English gas-fire, the efficiency of which in heating a room he compared with that of the typical reflector gas-stove produced by German firms. The results, which were reported in the "JOURNAL" for the 5th ult. (p. 671), showed that the English fire was superior in respect of small size, simplicity of construction, low cost of production, and duty or smallness of gas consumption. This conclusion will not be surprising to English gas men, whether or no they have had personal experience of German reflector gas-stoves, for the Gas Heating Research Committee of the Institution of Gas Engineers, in the report which they issued in 1910 [see "JOURNAL," Vol. CX., p. 810] showed that the percentage of heat radiated by such a stove was only 26 per cent., as compared with 40 to 48 per cent. for iron-fret and modern fireclay "fuel" gas-fires. The duty of the latter type, moreover, has since been increased. But Mr. Körting's report has come as a bombshell among the German makers of gas-stoves, who, with the insularity which in recent years has become a surprising characteristic of most technical men in Germany, had failed to keep their knowledge abreast of progress in other lands. The letters from two of the best known German makers of reflector stoves, of which summaries are given on another page of to-day's "JOURNAL," display an ignorance of the modern English gas-fire, and a conceit as to the merit of their own productions, to which it would be difficult to find a parallel. It is sad to see the name of Siemens appended to one of the letters.

Mr. Körting, in the reply which follows the letters of the German stove makers, does not attempt to debate the *quasi*-scientific issues with which they seek to whittle away the facts and depreciate the conclusions of his investigation on the respective merits of the two types of gas-fire. He amply justifies his position by merely pointing out that one of the London gas companies—the South Metropolitan—has alone succeeded in letting on hire 33,000 gas-fires of the English type, whereas working with the German reflector type the most strenuous efforts of his Association have placed a paltry 1500 gas-fires on hire among consumers in Berlin. The great disparity in the popularity of the two types which these figures display is consonant only with very real superiority of the English gas-fire. Naturally, he resents the disability under which the German gas manager labours, with the native reflector stove, in promoting the use of gas for the heating of dwelling-rooms, and calls upon the German manufacturers to provide a fire which will prove as low in first cost, as efficient, and as popular as the English type. Some readers of the "JOURNAL" may wonder that the British manufacturers of gas-fires have not, in virtue of the superiority of their wares, succeeded in disposing of large numbers of fires in Germany; but there are, we think, several reasons why they have not done so. Firstly, there is a heavy import duty, the effect of which in this instance would appear to have been that the gas consumer has been practically restricted in his choice of gas-fires to the highly-priced though obsolete and inferior patterns which the native manufacturers are pleased to supply. Secondly, there is the great prejudice against foreign productions, which the good opinion of modern Germany in itself in respect of technical and scientific things fosters to an extent which only those who have been keen observers of the country in recent years will realize. Thirdly, the English gas-fire manufacturers have been so busily engaged in meeting the demands of their own market that they have not tackled very seriously the possibilities of export trade. Despite the import duty, however, we believe that the best English gas-fires should find, with proper exploitation, a ready sale in Germany, where business in the heating of dwelling-rooms by gas is still in its infancy.

The Siemens regenerative reflector gas-stove had an ephemeral and restricted reign of popularity in this country towards the close of the nineties, owing mainly to an exposition of its merits which Professor V. B. Lewes gave with his customary convincing eloquence in a lecture delivered before the Incorporated Gas Institute in 1895 [see "JOURNAL," Vol. LXVI., p. 21]. Disillusion awaited those who adopted the stove. Costly in first instance, its working life was very short. The regenerative passages and the flue soon fell to pieces through corrosion, the flames became irregular, and unburnt or partially burnt gas was discharged into the room before the circulation to the flue had become established. Moreover, the radiating efficiency of the stove was lamentably low, and dust carbonized by the large expanse of overheated upper surfaces produced pronounced stuffiness in the

air of the room. Though the name of Siemens is one with which to conjure, it is a wonder to us, after exhaustive trial of a number of examples, that the Siemens regenerative reflector gas-stove finds any users at the present day.

There are one or two of the observations made by the two German gas-stove makers in their letters which contain gross misstatements in regard to the English type of gas-fire. Its high efficiency is attributed largely by both of these firms to escape of flue gases into the room. Herr Siemens argues that such escape must occur, because the flue of the English fire is only about 1½ inches wide, whereas with the German reflector stove, having a lower gas consumption, a flue 3½ inches wide is provided. He appears to be ignorant, however, of the fact that the English flue is not circular throughout, and, at its shallowest part, is 12 inches broad. Actually the flue of the English fire in question has a cross sectional area of about 24 square inches, but that of the German stove is about 9½ square inches. If there is anything at all in Herr Siemens's arguments in this direction, the conclusion would be that it is doubtful if the reflector stove has an adequate flue! This doubt is confirmed from our own experiences with Siemens's fires, of which the smaller examples had circular flues 2¼ inches in diameter and the larger 3⅝ inches in diameter. In modern English gas-fires, flues of more liberal dimensions are ordinarily provided.

Mr. Körting refutes the charge made by the German stove manufacturers, that flue gases are usually discharged from English gas-fires into the air of a room, by reminding them of the standing objection of English people to a "stuffy" atmosphere. The manufacturers say that he omitted to determine the proportion of carbonic acid in the air of his experimental room when the English fire was in use. We may supply the omission. In an occupied room with closed door and windows, immediately above and in front of the canopy of a fire of the same make and pattern as that examined by Mr. Körting, we have now found five volumes of carbonic acid per 10,000 volumes of air. This result proves that the English gas-fire was actively aiding the ventilation of the room. If the German stove manufacturers ask for further evidence of this character, there will be no difficulty in supplying it. Evidently, from the remarks of one of them, to the effect that little importance appears to be attached to the quality of the air in rooms in England and France, they are not aware that thousands of determinations of the carbonic acid in the air of large and small factories, &c., are made annually in this country for the purpose of controlling the adequacy of the ventilation, and that any discharge of flue gases from an English gas-fire into a room would long since have been detected and exposed, if it occurred, by officials who have no interest in the promotion of the use of gas-fires. We believe no such rigorous Government control of the ventilation of factories, workshops, &c., prevails in Germany, so that similar testimony to the adequacy of the flue of the German reflector gas-stove must for the present be wanting. But the charge that the modern English gas-fire contributes to the vitiation of the air of the room is one which must inevitably recoil on the heads of the firms who have made it—in ignorance, rather than in spite, we are willing to assume.

Parliament and Municipal Trading Finance.

Profession and promise constitute one thing; act may represent something altogether different. For some sessions past, the parliamentary authorities have professed and have given promise through their decisions that they were going to take in hand the question of the limitation of the rate-aiding appropriations of profit from municipal trading undertakings, or to discontinue the system altogether, in order to put an end to the abuse to which the parliamentary authorization has been submitted. And, further, towards the close of the Private Bill work of last session, some indication was made, when dealing with the Milford Haven gas measure, that the parliamentary authorities were resolved to terminate the unlimited capital powers that could be obtained by local authorities *viâ* the Local Government Board without coming periodically before Parliament for review, and to give an account of their stewardship. The use that can be made of the Local Government Board has been illustrated generally by a long history in municipal trading, and specially quite recently by Salford. In respect of the statutory conditions as to limitation of profits and restriction of capital, these have hitherto been diametrically different as between private and municipal trading enterprises. Everything, in fine, points to the whole question of municipal trading finance requiring to be dealt with on a systematic and uniform basis. But so far this session there have not been any symptoms of parliamentary effect being given to the professions and promises in these matters of definite control. Several Bills have already passed through the ordinary procedure in one House, without amendment in these respects; and they will soon be passing through the formalities and customary examination in the second House. So that there is yet time to make amendments. It is only reasonable to expect, and therefore it is not unreasonable to ask, that there should be co-ordination of the practices of Parliament in the directions referred to.

Let us take, as an example, and with no other intention, the Sidmouth District Council Bill for the acquisition of the property and powers of the Sidmouth Gas and Electricity Company, under the authorization conferred by the purchase clause in the Company's Act of last session. Here the Council are given (so far as the Bill has gone) the power to borrow the requisite sum for the purchase of the undertaking, the loan to be repaid in thirty-five years (instead of the forty years mentioned in the Bill as deposited); and likewise working capital to the amount of £2000, repayment to be made within ten years. So far so good. But then (unless an alteration is made in the House of Commons), without any further appearance in Parliament for an indefinite time, the Council, as the Bill stands, will be able to borrow to any amount by merely obtaining the sanction of the Local Government Board. Why should the Sidmouth or any other Council have this right, and the consequent exemption from parliamentary review, any more than the Milford Haven Council, who had restriction in this regard put upon them last session? If there is to be reformation in this matter of the parliamentary control of the finances of the trading undertakings of local authorities, let us have the process of unifying procedure carried on systematically, and not in the spasmodic and incongruous manner that is now being witnessed. The same with the amount of profits that may be transferred in aid of rates. The House of Lords has not limited this in the case of the Sidmouth Council. If it was right to limit or deny profit appropriation in the cases of Stalybridge and Dukinfield, Glastonbury and Street, Stoke-on-Trent, Oldham, Glasgow, Kirkcaldy, and Salford it is right to do so in the cases of Sidmouth and other local authorities who are before Parliament this session in connection with trading concerns. As we have pointed out before, should there be any call upon the rates through a deficiency of profit, this can be easily repaid by, if necessary, adjusting charges so as to ensure an adequate revenue for all purposes.

In certain other respects, the Sidmouth Bill has been amended during its progress thus far; but why not in the matters to which allusion has been made, we cannot even conjecture. It is observed that provision has been made for the sale of plant, on the ordinary conditions of notice and parliamentary authority, in the areas of administrative authorities outside the Sidmouth district. The modern gas-testing powers have been applied; the usual powers to retain or sell lands have been inserted; the power to let on hire electrical fittings has been conferred, providing the wiring and sale of fittings are done through a contractor. All charges, too, are to be so ordered that they will meet the expenditure on this branch of the business. But these modernizing introductions require supplementing—not only in the Bill taken as an example, but in several others—in order to help forward uniformity of parliamentary practice, to produce control over municipal finances in relation to trading concerns, and to protect the section of the community patronizing these concerns. In most legislation, defects of one kind or other can be found. It is the duty of Parliament to, from time to time, amend the defects, whether congenital or the product of changed conditions. Here we have some glaring defects in relation to municipal trading concerning finance; and Parliament ought not to allow any opportunity to pass of rectifying them, or of preventing their initiation in fresh places. Parliament knows of the abuse in many cities and towns of the powers to which we have referred. Then why not apply preventive conditions on the transfer of a concern from a company to a local authority. The Sidmouth Gas Company have had their dividends limited; and their capital powers have been defined by Parliament. Along come the Council, and ask for purchasing powers, accompanied by the right of unlimited profit appropriation, and an exemption from parliamentary review when fresh capital is required. If the

request is acceded to, it would be interesting to learn from the parliamentary authorities the reason why, in face of the signs of a changed attitude in certain cases of late years, and why in the name of equity.

Carbonization Studies and Standards of Quality.

THE third of Dr. Davidson's contributions discussing the considerations that the gas engineer should bestow upon the choice of a horizontal or vertical retort plant is published this week; and those who are proposing to take part in the debate on these studies and conclusions at the special meeting of the Midland Association towards the end of this month, will find in the present instalment several matters that will assist in energizing them, and will consequently provoke a lively discussion. It will be found that, in some measure, Dr. Davidson has trespassed a little beyond his main theme, and yet the points that we have in mind are germain and relevant to it, and, indeed, they carry us to what after all is the terminus to the line of considerations. Over them, however, there is certain to be disagreement, though rather in the nature of degree than in aught else. Nevertheless, the degree just at this time is a matter that is very material.

It is clear that Dr. Davidson has a benevolent spot in his heart for the user of the flat-flame burner; and if we are not mistaken, he would still allow this backward member of the community to exert some controlling influence over the technical and natural developments of the gas industry—in fact, he would have consideration given to him so long as he and his like can maintain a 10 per cent. part of the consumption, and so long (despite the fact that 90 per cent. of the gas is consumed for purposes other than flat-flame burners) the gas industry should be saddled with an illuminating power standard. There will be few who will consent to the proposition that the flat-flame user should today retain the dignity of final arbiter in this matter. But, of course, while the standard of value has an illuminating power basis, we must have regard to it; and therefore there is warning by Dr. Davidson against any over-pulling, the effects of which are much more disastrous in the case of illuminating power than in that of calorific power. The fact is not presented as a new one; but what the author of the article has to say in regard to it (taken together with the results of his experiments) is particularly interesting as well as explicitly stated.

In considering what will be the very contentious matter as to the proper standard for gas, Dr. Davidson, both on technical grounds and with the lingering tender feeling for the flat-flame user, suggests a calorific value—anyway under Birmingham conditions—of 500 B.Th.U. net, and, with the No. 2 burner, a subsidiary illuminating power standard of 15 candles, calculated to a consumption of 5 cubic feet per hour. If these standards are intended also as suggestions for general application, their expediency will be, from an all-round consideration of technical, commercial, and economic conditions, keenly challenged from many parts of the country. The 500 B.Th.U. *net* and the 15 candles will be considered too high, the retention of illuminating power even as a subsidiary standard unnecessary, and the "net" calorific value is not in sympathy with the views of the Metropolitan Gas Referees or with those (generally speaking) of the experts of probably all countries other than France. It is quite clear, accepting the argument and the considerations put forward in the article, that had Dr. Davidson placed the illuminating power standard at a higher point than 15 candles, he would compel all those who adopt, at any rate, the intermittent vertical retort system to work their charges shorter hours and at lower temperatures. In this connection also, it will be found that there is a leaning on the investigator's part, as the result of his researches and studies, towards the horizontal retort, on the side of which he thinks, with the standards he suggests, the safety of margin is larger than in the case of the vertical retort.

However, it must be said, before concluding this reference (in which we have, pending the discussion at the Midland meeting, refrained from comment more than to the extent of the superficial allusions necessary to point the interest of this third contribution), that Dr. Davidson again emphasizes the economic conditions of vertical retort working, from the manufacturers' point of view, in connection with the yields of tar and ammoniacal liquor and the reduction of sulphur compounds and naphthalene, together with the saving in labour. He reduces these to money values, and also touches upon the capital expenditure, in relation to which Dr. Bueb (in the article published last week) claims that life and wear and tear in association with Dessau retorts must not be overlooked. There are further subjects that will supply us with supplementary articles from Dr. Davidson's pen—such as "Steaming Vertical Retorts," "Tar from a Carbonizer's "Point of View," and "Nitrogen, Free and Fixed, in Coal "Gas." To say the least, Dr. Davidson is providing a large field within which those polemically inclined can have a battle-royal, under both the banners of technical and administrative expediency.

Gas Production from Unmined Coal.

THE cure that Sir William Ramsay suggested (at the opening of the recent Smoke Abatement Exhibition) for coal strikes, and simultaneously giving relief from the necessity for mining and raising the natural fuel of the country to the surface, as well as a means of escape from the air-polluting nuisance occasioned by the burning of the raw fuel, has—just at this time—aroused a considerable amount of attention, and the practicability of the project has been received by the Press of the country precisely in inverse proportion to the amount of technical and scientific knowledge that could be brought to bear by the writers upon the problems that surround it. It will be remembered that (to put the proposal in as few words as possible) the suggestion was the conversion of the coal mines of our country into huge underground gas-works, so producing gas without raising the coal to the surface, conveying the gas to the pithead, using it there in gas-engines for generating electrical energy, and thence transmitting the current to all parts of the country. Sir William did not say how he proposes to comply with the world's requirements for coke for iron, cement, and the hundred-and-one other manufactures and purposes for which its high calorific value and cleanliness are needed, nor did he say how he proposes to supply the residues of coal carbonization from which 140 or so products are derived, with which the world cannot now do without. If he is going to supply coke and the liquid materials to respectively the iron and other works and the chemical manufactories from the bowels of the earth, then he might just as well, from the points of view of weight and bulk, allow things to remain as they are. Nor again does he tell us how he is going to compensate the world for the loss of heat units between underground carbonization and conversion to electrical energy, as well as during its uneconomical transmission throughout the country. Yet the President of the British Association was bemoaning only last summer the comparatively short life-duration of the coal measures, and the wasteful use that is still being made of our coal resources!

But Sir William, in the first instance, only referred as a dream to his proposal to turn coal mines into gas producers; but it is a dream in which he has some amount of faith, inasmuch as, report says, he has accepted the offer of a coal mine owner of a pit wherein he can make an experiment. Sir William firmly believes that every factor in the problems surrounding such a scheme is known, save what may happen in connection with the combustion of the coal underground. Several ugly ideas flit across the mind every time we remember this exception. As long, however, as no ill befalls, the experiment would be—it would sure to be with Sir William at the head of it—useful in adding to human knowledge; but as to any real industrial good arising from it, all practical considerations seem, at this stage, to offer a decided negation.

Of course, the idea of the pithead production of gas and the generation of electricity, and their transmission throughout the country, are schemes that have long held fascination for some of our most advanced workers; but the schemes have never developed beyond their inchoate stages—coming to grief from whatever direction approached to test their economic soundness. Sir William goes beyond them by proposing not to raise the coal to the pithead; and, by so doing, he introduces, so far as he has let light fall upon his project, far more serious problems than any of the pithead schemers of a past day. But he is not the originator of the scheme for producing gas from unmined coal. He has a predecessor—a Mr. Anson Gardner Betts, of Troy (N.Y.), who took out a patent in 1909 for an invention contemplating precisely what Sir William proposes, although differing in detail, and proposing, too, the transmission of the produced gas, not its conversion into electricity. The specification

of the invention is published by us this week (p. 95); and it shows some of the difficulties the inventor anticipated, and with which Sir William, if he goes forward, will also meet. Mr. Betts' scheme remains where it was—on paper. How far beyond it will Sir William Ramsay's scheme advance?

The Ilkeston Gasholder Disaster.

INTEREST in the Ilkeston gasholder disaster has now spread far afield. As the "JOURNAL" testified last week, it has attracted the attention of Professor F. K. Th. van Iterson, of Delft; and by the aid of the drawings, photographs, and evidence published in the "JOURNAL," he has made a theoretical investigation into the cause of the somewhat still mysterious happening. The article is both a clever and an instructive one; and we welcome such a contribution into our columns from one so capable of scientific investigation into the subject. It was the drawing that Mr. J. Ferguson Bell gave us an opportunity of publishing that supplied Professor Itersen with the needful data for calculating the stresses existing in the Ilkeston holder when exposed to exceptional atmospheric conditions; and photographs and evidence furnished him with points of support for the deductions that he has made. But, of course, Professor Itersen does not put forward in any dogmatic spirit his conclusions based on theoretical calculations and circumstantial evidence. He is as well aware as we are that there may be defects in his premises drawn in some degree from a chaotic condition of things, of which he has no intimate personal acquaintance beyond what has been published; and some of the evidence is, to say the least, of a pretty shallow kind. At the same time, it is an attempt, by scientific aids, to throw light on a matter that is of considerable engineering importance and therefore interest.

To put the matter briefly, Professor Itersen is of opinion, from his examination of the material at his disposal, that it is possible that the bursting of the tank was a consequence of a weak part in the structure. He cannot arrive at any other conclusion; and it is because he believes this, and because he thinks that it is time there was a little monition on the subject of excessive economy in material, especially in the compression members, that he has written his article. Such a warning we are sure will not go unheeded—more especially when our monitor is able to point to the fact that other prominent gasholder catastrophes in the past fifteen years have been due, without question, to structural defect. We are gratified, however, to find that not one of the illustrations which he quotes has been the work of gasholder contractors in this country. This is not said boastfully, but is merely presented as a fact, because the gasholders of the contractors of this country have, if anything, erred on the side not of excess in economy, but of excess in material. This Ilkeston holder, as a matter of fact, is the first of any modern structure in this line in this country that has met with a fortuitous end. Professor Itersen is quite catholic in his treatment, in the illustration of his point, and in his warning. Engineering like pure science knows no national bounds at all; and our contributor clearly writes from the universal standpoint.

There is an aspect of the article before us that will have been immensely gratifying to the inventor of the system as well as to gas engineers of this country; and it is Professor Itersen's tribute to the sound principles of the spiral-guided holder. As we have done from the first account that was received of the details surrounding the Ilkeston accident, he asserts that the occurrence cannot be imputed as a fault of the system; and, as a matter of fact, in his opinion, spiral-guided holders are safer in a gale than are ordinary guide-framed ones. This view is demonstrated by practice, and can be proved by theory. As to the theoretical proof, speaking as one competent to do so with authority, he points out that the calculation for spiral-guided holders is less uncertain than for other types. By a brief exposition of the forces coming on the different members of the structure, he shows this. He goes further, and declares—this is important—that the result of theoretical investigations is that the larger spiral-guided holders are made, the more pronounced are their advantages over those with guide-framing. These are points that are worth emphasizing—coming to us from this authority. They are points that will assist in hardening judgment that may in some places have become a little shaken by the Ilkeston accident; and they certify the correctness of the view in this country that the spiral-guided holder is an engineering invention of the first scientific merit.

British Commercial Gas Association.

Several excellent advertisements from the British Commercial Gas Association have been appearing in the daily papers; and the publicity campaign has thus been well started. The advertisements have been inserted in papers of general circulation, from "The Times" down to the half-penny morning and evening papers of the large sections of the community that work in office, shop, factory, and in other places both normal and abnormal. The cooker season is upon us, and the season, too, when hot water is required but the kitchen range is not in use. The advertisements have been largely directed to these matters; and therefore they have been appropriate to the season and to the strain under which the country has been labouring through the coal strike. Besides their fitness in these respects, it will have been observed by our electrical rivals that the announcements have been kept to the one topic—the utilization of gas for these and other purposes.

The Smoke Abatement Exhibition.

The Smoke Abatement Exhibition at the Agricultural Hall closed its doors on Thursday night. Inquiries among some of the exhibitors show that, while in the earlier parts of the day there has not been any considerable attendance of the public (this is usual at such exhibitions), as the day has advanced visitors have arrived in increasing numbers, and during the evening the peak attendance has been reached. The stand attendants speak of the visitors as having been highly interested in the exhibits. The centre of attraction, especially in the evenings, was the cookery demonstration room of the Gaslight and Coke Company, in which the lectures, demonstrations, and competitions were carried on under the superintendence of Miss Helen Edden. So great were the gatherings of listeners and spectators during the evenings that, at last Wednesday evening's competition for men, it was found necessary to restrict admission to holders of tickets. The practical work that was done in this demonstration room during the run of the exhibition is bound to have excellent beneficial results.

Sales of Gas Act Once More.

The question of the amendment of the conditions of the testing of meters will never be allowed to rest until there is more compatibility than now exists between them and requirement. The matter comes to the surface at intervals; and somebody tries to exert influence in interested quarters in hope of a definite movement being made. About five years ago, the London County Council called the attention of the Board of Trade to the question of the amendment of the Sales of Gas Act; and we see that Mr. Hume, the Gas-Meter Inspector for the City, is now urging the Corporation to approach the Government for the same purpose. There is no opposition from the gas industry to amendment, providing it is reasonable, and conforms with the present-day conditions of gas supply. Amendment under such circumstances would be welcome. To ensure proper conditions, the Institution of Gas Engineers and the Gas-Meter Section of the Society of British Gas Industries would naturally be consulted. When the London County Council were moving in the matter in 1907, the bodies named conferred together, with the result that a letter was addressed to the Standards Department of the Board of Trade, asking to be heard in the event of any amendment being contemplated. The reply was that, in such an event, the request would be remembered. But five years have passed, and nothing has been done. An article, by Mr. F. Coe, of Nottingham, on the general subject, was published in our columns last week (p. 21).

Trade Union Freedom.

Emphasis was laid upon the effect of the Trade Disputes Act in conferring immunity upon the unions, by a judgment which was delivered in the Court of Appeal some days ago. A firm had brought an action against a trade union and other persons who were its officials for libel and for conspiracy to publish libels of, and to induce people not to deal with, the plaintiffs. The union thereupon took out a summons for an order that the name of the union should be struck out of all the proceedings in the action—on the ground that, by section 4 of the Trade Disputes Act, an action of tort was not maintainable against a trade union. The Master made an order striking the name out, as asked; but, on

appeal, this was reversed—the opinion being expressed that the point was one which ought not to be dealt with summarily, but at the trial. Thereafter, the union went to the Court of Appeal, where, by a majority, they were successful. From the report of the judgments appearing in "The Times," it is noted that Lord Justice Vaughan Williams expressed the opinion that the general words of subsection 1 of section 4 of the Trade Disputes Act seem *primâ facie* to relieve trade unions, whether of workmen or masters, and any members or officials thereof, on behalf of themselves and all other members of the trade union, in respect of torts alleged to have been committed by or on behalf of the trade union, from the common-law liability to be sued for torts. He proceeded to point out that the sub-section does not provide a defence which may be pleaded, but states that no such action shall be entertained by any Court. In his view, according to the ordinary canons of construction of the words in an Act of Parliament, not only should such a section be construed strictly, but also the Legislature must be taken to have intended that a reasonable interpretation or construction should be put upon the words of the Act. The words "trade union" throughout the section must be read as meaning trade union as such. What had been done in this case plainly related to matters affecting trade unions and workmen as such; and he had no doubt that the action was one which could not be entertained in any Court. Lord Justice Kennedy agreed with this view; but Lord Justice Farwell delivered a dissenting judgment, stating that, to his mind, the action should go to trial, and the actual facts of the case be proved in the usual way. Lord Justice Farwell came to the conclusion that the tortious acts in section 4 were confined to acts "in contemplation or in furtherance of a trade dispute;" but Lord Justice Vaughan Williams, in his judgment, stated that, whether or not this were so, would make no difference in the present case, as the libel was in contemplation or in furtherance of a trade dispute by the trade union as such. It appears that what the union had done was, in effect, in the publication of a "fair list," to accuse the plaintiffs of unfair dealings with their men in the course of their business.

The Coal Position.

A feeling of relief went through the country last week when the first break in the coal strike was seen; but at the time of going to press [earlier than usual in view of the Easter Holidays] the delegates of the coal miners are sitting in London discussing whether or not ratification shall be given to the recommendation arrived at on Thursday by the Federation leaders that work at the mines should be at once resumed. The leaders are divided on the point; but the extremist leaders who in any way assist in fostering the feeling in certain districts against an immediate return to work are not only enemies of the country at large, but of the whole of the industrial workers of the country. If, however, the outcome of the conference should result in an immoral adverse vote, it will have little effect, excepting perhaps—and unfortunately—in the coal-fields from which the gas industry chiefly draws supplies, and the miners in which fields can boast of treasuries still containing considerable reserves. In the ballot that has just been taken, Yorkshire only polled 13,267 votes in favour of the resumption of work, while there were 43,914 against. In Durham, 24,571 votes were cast in favour of a return to work; while 48,898 were given in opposition. In Northumberland, 10,674 votes were registered on the side of resumption; and 14,195 against. Taking the country through, there were a large number of miners who did not vote; but of those who did 201,013 were disinclined to continue the struggle, while 244,011 were favourable to its continuance—thus giving a majority of 42,998 to the latter. The ruling, however, that as a two-thirds majority of the men voting is required to command a strike, a similar majority is requisite on a ballot for a continuance of a strike, has had a good effect in some districts; and empty union coffers have also been a persuasive force. The drift-back to the mines that commenced last week is another element in the situation that must, lead to a general resumption of work. If the vote confirms Thursday's recommendation, strike pay will be stopped and this will have a wholesome influence upon the miners still inclined to rebel against reason. Therefore, however the conditions are marshalled and examined, they point—despite the efforts of the few malignant advisers of the men—to the coal-fields being very soon in full swing again.

The Immediate Future and Contracts.

The sooner the better. But rail and sea transport will govern deliveries, and the early replenishing of stores. Precedent gives small hope of the railways doing anything of a particularly notable character in the matter of distribution. At the present time, wherever one travels, in any part of the country, sidings are found packed with empty coal-waggons, which have been left, as it were, derelict in order to save the transit of "empties" while fuel supplies for the railways were not available—thus assisting in husbanding fuel stocks. The companies cannot be blamed for this. But the generalship of the companies will now be judged by the expedition displayed in getting the means of conveyance to the coal-fields, and in distributing about the country the coal as raised. This should be their first concern. Meantime, many gas undertakings have emptied coal-stores the floors and dark recesses of which have not been seen for many a long day; and the managers of these concerns will not be the least among industrial compeers who will be glad to witness the beginnings that will lead to normal deliveries. The undertakings that have still fairly considerable stocks of cheaply purchased coal, and can hold out for the resumption of deliveries under their contracts, will not be hard-hit financially; but those that will have to buy in the open market anything that is offering during the next few weeks will, we fear, have to pay pretty dearly for it. The recommencement of work does not by any means denote that the industries of the country are out of the wood. The depletion of coal distributed throughout the country will, having regard to current requirements, take a considerable time to make good. The competition, too, that there will be in all industries to make ample provision for the future will have some effect on prices. That is inevitable. The Minimum Wage Act will also be made a reason for a higher level of prices. Against these conditions, all that can be hoped for in the way of partial compensation is that some of the heavy export contracts have already been transferred to other countries. Cheap coal will not be found in the immediate future; and the season for coal-contract making for the gas industry is upon us. That is unfortunate. Contracts entered into before the strike were at a fairly reasonable level, having in view the prospects; but the administrators of gas undertakings that have not yet concluded contracts will be doing the right thing to postpone their settlement as long as possible, or until conditions have reached a more composed state—watching meantime for any coal that may be on offer at reasonable rates—unless, of course, the collieries and their agents are disposed to look to the future as well as to the present, and adopt a spirit of reasonableness towards their long and large contract customers.

Gas-Engine Efficiency.—Writing on this subject in "Cassier's Magazine" for the current month, Mr. John Batey says: "It is evident that a slow-running gas-engine must give a higher conditional efficiency than the small high-speed motor engine. The reason is not far to seek, because the gas-engine cylinder, by its size, holds a greater quantity of hot gas exposed to a relatively smaller surface than the small-capacity motor cylinder. This is quite in accordance with common knowledge, because the area increases as the square of the diameter, whereas the surface increases directly as the diameter; and it is also well known that the temperature of a small body of gas for one mixture condition is only equal to that of a much larger body. Therefore, the relatively smaller dispersing surface of the gas-engine cylinder is entirely in favour of efficiency. As a practical determination for the heat of a gas-engine cylinder, it should never be allowed to exceed the temperature given by the makers."

Rutter's "Hours Wages Calculator."—We have received from the publishers, Messrs. M'Corquodale and Co., Limited, of No. 40, Coleman Street, E.C., a copy of their new "Hours Wages Calculator," specially compiled for the use of gas companies, by Mr. C. H. Rutter, of the Brighton and Hove Gas Company. The calculations have a large range—proceeding by farthings from 2d. up to 11¾d. per hour. Where ¼d. is part of the result, it is not shown; but in the case of ½d. or ¾d., the next 1d. higher is given. The figures are very clearly printed; the rates per hour and the number of hours (which go up to 80) being in black type. The calculations are divided at each farthing by thin lines, and at each penny by thick ones; and these are also used respectively to divide the number of hours into fives and tens. The rates per hours are also printed in large figures in red in the centre of each group; so that the eye is attracted at once to the particular group required. The calculations occupy two sheets (each 17 in. by 10 in.), mounted on stout cloth boards, arranged to fold in the middle. The price of the "Calculator" is 3s., or 3s. 4d. if sent by post.

PERSONAL.

At the meeting of the Institution of Civil Engineers on Tuesday last, Mr. JOHN WOODHEAD SMITH, the Resident Engineer of the Bury Corporation Water-Works, was elected an associate member.

Mr. SMITH WHITEHEAD, the Assistant to the Borough Engineer of Nelson, has been selected out of 95 applicants as Water Engineer to the Nelson Corporation. Mr. Whitehead is a native of the town, and has recently had charge of the engineering work in connection with the Corporation Water Department.

Last Thursday Mr. Alexander Masterton, the Engineer and Manager of the Edinburgh and Leith Corporations Gas-Works at Granton, in the technical office there performed a highly pleasing duty. In the name of the staff, he made Mr. EDWARD H. SCOTT, D.Sc., the Chemist, the recipient of a number of technical volumes (as a mark of the esteem and regard in which he was held by his colleagues), on his leaving the office to take up the duties of Chief Chemist at the Salford Corporation Gas-Works. Mr. Masterton, in the name of the officials and staff, congratulated Mr. Scott on his promotion, and wished him success in his future sphere. Mr. Scott responded in a few well-chosen sentences, and thanked his friends for their good wishes.

OBITUARY.

The "Co-Partnership Journal of the South Metropolitan Gas Company" for the present month contains an announcement of the death of Mr. J. G. D. SOMERVILLE, who had been in the Company's service since October, 1887. He was first engaged at the Rotherhithe station; but in 1890 he was removed to the office of the Chief Engineer, where he remained for some years. In the latter part of his life he was in the canvassing department. He was a son of Mr. John Somerville (a member of the Company's engineering staff), and died at the early age of forty-one.

An announcement in the "Obituary" columns of "The Times," of the death on the 1st inst., at "Mavis Bank," Upper Norwood, of MARY ANN, wife of the late Mr. ALEXANDER ANGUS CROLL, will take the thoughts of some of our readers back to the early days of gas competition in the City of London. Mr. Croll was Engineer of the Great Central Gas Company, whose works at Bow Common passed into the hands of the Gaslight and Coke Company on the amalgamation of the undertaking in 1870. In the early fifties, Mr. Croll occupied a conspicuous position in the gas industry. He died in June, 1887, at the age of 76; and his widow was in her 88th year at the time of her death.

The South Metropolitan Gas Company have lately lost, by the death of Mr. THOMAS SLATER, one of the few remaining officers who served under the late Mr. Thos. Livesey. The father of the deceased was employed by the Company, and his son entered their service in 1861, and passed through various grades until, nearly twenty years ago, he was placed in charge of the show-room at the chief offices. This position he held until his death, which took place on the 1st ult., after only a few days' illness, in his sixty-fifth year. Writing of him in the current number of the Company's "Co-Partnership Journal," from which the preceding particulars have been taken, the Editor says "his unfailing good humour and sociable disposition won him a large circle of friends." A goodly number of officers and pensioners were present at the interment in Lewisham Cemetery, to pay the last tokens of respect to their comrade of so many years.

DR. W. VON OECHELHAEUSER'S CAREER.

IT was mentioned in the "JOURNAL" for the 26th ult. (pp. 860 and 911), in connection with the retirement of Dr. W. von Oechelhaeuser from the position of General Manager of the German Continental Gas Company, that he had held that position since Jan. 1, 1890, and had for 31 years been associated with the Company. Some few particulars were also given of the progress the Company have made during this time; but these may now be appropriately supplemented by details as to the striking advances effected under the guidance of Dr. von Oechelhaeuser, who was appointed Chief Engineer to the Company on July 1, 1881.

Since that date there has been an increase in the output of gas per annum equivalent to 173 per cent., notwithstanding that three of the largest districts supplied—Lemberg, Marcus-Gladbach, and Erfurt—passed into the hands of the local authorities during the period, and the largest town supplied (Warsaw) was for two years in such a disturbed state that there was a decrease for the time in the consumption of gas there. The number of officers of the Company has risen from 147 in 1881 to 615 at the present date; and the number of workmen employed has increased by 154 per cent. The relatively small increase in the number of workmen is accounted for by the increasing use of machinery on the gas-works. The relatively large increase in the official staff, on the other hand, is attributed to the accession of electrical business, the establishment of a chemical works and central workshops, and the necessity for greater activity in pushing the sale of gas in the face of competition.

During Dr. von Oechelhaeuser's connection with it, the Company have established their chemical works at Warsaw, the electricity works at Dessau and at Hagen-Eckesey, the cross-country electricity supply station in Anhalt, and the central gas supply works for the Elbgau and Upper Silesia. They also erected their central workshops at Dessau, and adopted novelties and inventions emanating from their technical staff—such as cyanogen recovery, naphthalene extraction, and special types of vertical retorts and prepayment gas-meters. Subsidiary companies were established at Frankfort-on-the-Main for working up residual products, and at Berlin for exploiting the Dessau system of vertical retorts. Dr. von Oechelhaeuser invented the Dessau automatic bye-pass governor, and in 1898 the first large gas-engine with which his name is associated. He was instrumental in introducing a savings investment scheme for the employees of the Company, in establishing the first training school for gas-fitters in Germany, and in founding a "Central Organization for Promoting the Sale of Gas" throughout the country, which has its headquarters in Berlin. He negotiated new contracts and concessions for the supply of gas to Warsaw, Frankfort-on-the-Oder, Potsdam, Dessau, and a number of other towns and districts, and entered into working arrangements in connection with the supply of electricity in Anhalt.

ELECTRICITY SUPPLY MEMORANDA.

Economy in the Air—Effects—The Electricity and the Gas Account—Quantitative Exuberance—Petty Shafts from Electrical Quarters—Tariffs and "Other Purposes."

ONE effect of the coal strike is the respectable lesson in economy that the country has had. The diminution of train and electric tram services, the closing-down of works, the reduced spending power of a large section of the nation through unemployment, warnings from various quarters as to care in the use of everything dependent upon coal for its production—have caused the community to live the last few weeks in an atmosphere of economy; and a very deep impression has been made. The idea of exercising economy has obtained such a hold upon people that it has been practised even where it has not really been needed. But it has been a good lesson for some people. It has shown them that they can do with less of some things that they have been accustomed to; and this may have a salutary effect in many a household in future. From the household to the shop and the restaurant, there the same thing has been witnessed. The cosy fire to which one has been accustomed at the place where the wants of the inner man have been satisfied, has been absent; and there has been frugal use of lights, though the London suppliers—gas and electricity—have not, so far as we are aware, breathed a word about husbanding the supplies. In the public institutions, the command went round that the strictest economy should be practised. It was so at the General Post Office, and in other places. As a matter of fact, at the Post Office, the order was to spare the solid fuel and use gas for cooking and heating as much as possible. At the Patent Office, a rigorous control has been maintained over the electric lighting. No more electric lights were allowed than were required by readers and searchers. The attendants have been keeping tender watch over the lights.

The standard of need may be set for a period by the experience in these times, and will show its mark in the accounts of many individual consumers. One unfortunate thing (though we rejoice over the beneficial result to many householders) is that this great manifestation of economy—enforced and voluntary—has come at the end of a quarter when gas and electricity undertakings generally look for a large business, and it precedes the shorter hour lighting season. What with the closing of factories, and this prevalent idea of economizing, we are afraid there will be no very big increases of business to chronicle this half year—not even if the return to normal affairs in the matter of coal supplies causes manufacturers and others to try to make up leeway. What has been lost cannot be entirely recovered, no matter the amount of the endeavour. The electrical industry may approve of the economy that has been practised. It will have demonstrated to consumers how an account for electric lighting may be made lower than one for gas. By using the smallest possible units; by the whole household huddling together in a single room all the evening; by all the rest of the house being in darkness; and there you are—electricity for domestic purposes under such circumstances is less costly than gas used without restraint. But it has to be blazoned about—not less costly light for light.

There is not enough made by the gas industry of the cheapness of its light with modern burners. We came across a householder (his house is not a large one) the other day who has had the electric light installed; while the gas supply has been retained for cooking and heating. He used his electric lights with the same freedom that he had been employing his gas-lights. Result, an account for nearly £3 for electric light in the quarter; and a gas bill that was only reduced by about 17s. 6d. Until he saw the gas bill, he had little conception as to the small proportion of the total consumption of gas that had been used for lighting by means of incandescent burners. Most electricity consumers only use the current for lighting; they are prodigal if they employ it for heating, cooking, or water heating. But the householder who uses the gas supply

for lighting, cooking, heating, hot-water service, ironing, and so forth sees a larger bill for gas than his neighbour's bill for electric lighting only. We repeat that few consumers through the extension of the applications of gas really know how little gas they are using for lighting with modern gas-burners. It is a pity there are not some ready means of informing them. It is an expensive system to supply dual meters; but in an experimental case of which we know in which this has been done, the householders have been really astonished over the smallness of their lighting accounts. It has also impressed upon them the large amount of convenience and comfort obtained for the money paid for gas.

Stock statements regarding gas are common in the electrical press. They live until there comes a time when either out of consideration for the nerves of their readers or remorse on the part of the editors, the statements are allowed a temporary rest. But the renascence of the statements is as certain as anything can be. We are treated to a little change. The coal strike and the Smoke Abatement Exhibition have supplied an opportunity for the "Electrical Review" to exercise its wit in producing a few new declarations, which are especially noteworthy for their quantitative exuberance. How is this as an example: "*Many* stations in industrial areas have been experiencing a *great* increase in the demand for power supplies, in order not only to secure the economy and special advantages of electricity, but the freedom from dependence upon coal or gas." Electric tram services and public lighting may be curtailed in industrial areas, an electric lighting concern may even inquire whether local manufacturers have any coal to spare with which to keep the electric generating plant on the move; but the rush for, and granting of, power supplies it is understood from our contemporary have been great. It is clearly not the time to cast stones. But "many" and "great"—well, they look very much like the product of a fine, well-matured imagination. And what impish brain trickster induced the writer to add "or gas" after coal, when stating the assumed reasons for manufacturers adopting electricity? Then we come across an aged platitude: "The prices charged for electricity are so moderate that, apart from all the other advantages obtained from its use, it is the most economical source of power. But even if it cost the same as steam, gas, or oil per horse-power generated, the convenience of being able to limit the consumption to the actual power usefully employed, constitutes a considerable percentage of saving." Does our contemporary really realize why electricity for power has to be put at such "moderate"—very moderate!—figures? If so, it should exercise a little caution in talking of it as the most economical source of power.

Let us pass on to further example products of a vivid imagination. Now we are at the Smoke Abatement Exhibition. Speaking of the lecture hall and tea-room of the Gaslight and Coke Company that formed such an attractive part of the show, our contemporary says the restaurant (it should have said the tea-room) for obvious reasons is *not* in the same room as the gas-cookers." Really we do not know whether this statement should be attributed to a vivid imagination or to senility. But at any rate, the oblique suggestion is remarkably foolish. The most obvious reasons that we could see for the propriety of the division were the large audiences (*ante*, p. 20) watching the cookery demonstrations and listening to the lectures afternoon and evening; and it would have been the height of folly to have had teas served in the same place. The little-mindedness underlying the innuendo in our contemporary's remark is as obvious as were the crowds at these Gaslight and Coke Company's demonstrations. Further, we learn from the same quarter that "*several* firms whose names are literally household words in connection with coal and gas heated cooking apparatus have found it desirable to establish departments for the construction of electric-cookers." The term "several" means more than one; and, in order to establish the truth of the statement, perhaps the "Electrical Review" will publish the names of other firms than the one that does not limit, and never has for many years limited, itself to the production of heating stoves and cookers for any one form of fuel. Regarding our other contemporaries, there is only one point by "Meteor" of the "Electrical Times" that need be mentioned. He suggests that gas apparently did its best to crowd electricity out of the main hall at the exhibition. Is it not the fact that electricity particularly asked for isolation, and preferred not to line-up on stands facing the competitors? The exhibition was not intended to be one of pretty wall decoration, Russian bands, restaurants, refreshments, or anything of the kind, but of gas and electrical appliances for disestablishing smoke-producing fuel for heating, cooking, water-boiling, &c. From this aspect of the matter, as the "Electrical Review" would say, the electrical exhibits for very obvious reasons were better off for not being brought into too close contrast with the gas exhibits. As "Meteor" truly remarks, there were "many *old* friends" to be seen in the electricity hall.

Reference was made a fortnight ago to the fact that, like Mr. Seabrook, Mr. W. W. Lackie, of Glasgow, had been regaling the members of the Institution of Electrical Engineers with his views on the subject of tariffs, and with a description of the system he has adopted in Glasgow to get over the trouble of duplicate wiring and measurement, in order to encourage the use of electricity for purposes other than lighting. It is not supposed that anybody in Glasgow but the officers of the Electricity Department and people who have made a special study of these matters understands the system, but this does not particularly matter, so long as consumers are satisfied with their accounts. On this score, we have no information; but Mr. Lackie indicates that, in his opinion, it has given satisfaction during the past year, and has encouraged the use of electricity for purposes other than lighting. The preliminary indulged in by Mr. Lackie prior to developing his system was to investigate a large number of domestic consumers' accounts; and he found that, similarly circumstanced, they were practically consistent in the corresponding months of succeeding years in the consumption for lighting. The investigation gave him 800 hours as the approximate lighting maximum demand in the year. The charge in Glasgow is 3d. per unit; so that it was decided that all units consumed over the 800 hours' maximum demand should be at 1d. per unit. Bills are rendered every two months; and, in order to form a base for calculation having relation to the period's consumption, the 800 hours was divided into bimonthly sections as follows: Hours of use of maximum demand at 3d., June-July, 40; Aug.-Sept., 60; Oct.-Nov., 200; Dec.-Jan., 300; Feb.-March, 160; April-May, 40. The number of hours corresponds to the hours of darkness from sundown to 10 p.m. each two months; and it was found that the domestic consumers' accounts also gave approximately this result. It is evident that, as the demand for heating would be greatest between October and March, the accounts including heating in that period will look altogether disproportionate with those for the period between April and September; and this may lead to trouble. In constructing the tariff, many things were taken into account, including—lucky electric consumer!—an annual month's holiday. Beyond the 800 hours' maximum demand, all further units are charged at 1d. apiece. A year's experience shows that 500 consumers have installed apparatus of some kind or other for "other uses" than lighting. The accounts of these consumers show an extension of consumption to the amount of 21 per cent., which is equal to 7 per cent. in the revenue from them. The best that can be said of Mr. Lackie's base, is that it is only a rough-shaped one, and is not exact. There are divergencies between consumers and consumers, and between one consumer's consumption at different periods, allowing for seasonal differences. This is recognized by electricians, who long for the time when they can be quit of all this invention and manipulation to capture custom for purposes other than lighting, and have the several advantages of a flat-rate for all purposes. Will this time ever come under the conditions of electricity supply, and the low heating value of electric current? In the discussion on the paper, Mr. E. T. Ruthven Murray gave a useful average charge that falls upon an electrical undertaking. He said that, on an average, it costs 24s. a year per consumer for meter, accounts, &c.

The paper by Mr. Lackie was part of the new-born effort of the Institution of Electrical Engineers, initiated by Mr. S. Z. de Ferranti, to stimulate greater commercial energy for securing consumers for other purposes than lighting. Some electricians have visions of the domestic heating and cooking loads lying only a short space beyond their grasp; and yet they find it difficult to discover proper ways and means of bridging the narrow space. The "Electrician" recently succinctly stated the position: "We have reached a critical moment in the history of electricity supply. The domestic load is within our reach; but so far any station engineer who has taken up the matter has worked at it individually. The information on the subject is scanty, and often unreliable." The last statement is true; and so is the second one. It is surely a benefit that station engineers should work at the matter individually than that they should adopt a stereotyped course of action. But how on earth the "Electrician" knows that "the domestic load is within our reach," when "the information is scanty and often unreliable," seems to us to be a postulation with a mightily insecure foundation. It is, at any rate, not a very logical way of putting the position. However, as we have seen, the Institution of Electrical Engineers are moving to establish a closer connection between the technical and commercial interests of the industry. They are going to reinforce their membership from the commercial ranks by a new associate class, and the Council by the addition of commercial members; and the importance of this is being impressed by the informal discussions on commercial questions, with the view to giving greater impetus to the use of electricity for purposes other than lighting. It is true, as "The Times" puts it, that there must be a complete union between science and commerce. However, in the process of analyzing the reasons why, for "other uses," the householder persists in adhering to gas when "it is claimed that practically everything for which gas is now used can be carried out by electricity," there should not be omission of such facts as the superior heating value, economy, manageability, wider application, and reliability of gas, and of the cheapness in first cost and subsequent maintenance of the appliances by which it is used. The simplicity of the appliances also counts.

Masonic—Evening Star Chapter.

It may be mentioned that the Royal Arch Chapter being formed in connection with the Evening Star Lodge will be consecrated on Tuesday, the 30th inst., by Sir Edward Letchworth, Grand Scribe E. The regular meetings, it is arranged, will be held in May and November. The three principal chairs will be filled by W. Bro. W. A. Surridge, P.M. 120, W. Bro. Charles Meiklejohn, P.M. 502 (P.P.G.S.W., Warwickshire), W. Bro. J. W. Broadhead, P.M. 1231 (P.P.S.G.D., West Yorkshire). The first regular meeting of the Chapter will be held on Tuesday, May 9.

GAS-COOKERY DEMONSTRATIONS & LECTURES.

Some Useful Hints.

THE interesting series of gas-cookery lectures at the Smoke Abatement Exhibition continued to be well attended throughout last week; the Gaslight and Coke Company's consumers and many others from the Provinces eagerly availing themselves of this opportunity to gain valuable hints as to the best method of using their gas-cookers.

The point especially emphasized in the demonstrations, by the talented lecturer Miss Helen Edden, was the quickness of time in cooking various dishes, and the economy of fuel. A dinner of twelve dishes—soup, fish, joint, vegetables, sweets, and savoury—can easily be cooked in an ordinary gas-oven at a cost of one penny. The cleaner the stove is kept, the better the cooking results. The initial cost is to get the oven hot. This will take from fifteen to twenty minutes, using about 6 cubic feet of gas. After that the gas should be reduced to a tiny flame not more than ¼ inch long—in fact, rather less; so that a leg of lamb weighing 5 lbs. would be thoroughly cooked in one hour and three quarters, using about 21 feet altogether. While the meat is cooking on the lower shelf, fish, pies, and puddings may be cooked on the two shelves above; thereby cooking six to eight more dishes in the time, if need be, at the ridiculously low cost of ¾d., with gas at 2s. 6d. per 1000 cubic feet. Meat roasted in a gas-oven has a deliciously crisp taste; and by the proper method of gentle cooking, the shrinkage is small, and compares very favourably with any other method. Excess of heat will drive out the moisture or water contained in the joint; but it does not part with its nourishing juices. Excessive heat also tends to harden the fibres of the meat, rendering it tough and indigestible. Any one with a knowledge of cookery is aware of these points; but careless cooks do not take the trouble to think. The audience could not, however, fail to grasp these facts when presented to them in the lucid manner employed by Miss Edden.

The men's final competition, on Wednesday at 6.30, attracted a large gathering. There were eight competitors. The menu consisted of baked rolls, grilled chops, tomatoes, and boiled potatoes. These amateur chefs quickly got to work at a given signal. They peeled their potatoes, and put them on to boil; mixed the flour, butter, and milk, made the rolls, and placed them in the ovens. They then grilled the chops and tomatoes; and in thirty minutes from the start, the completed dishes on eight trays were handed down for the audience to judge. All were excellently cooked; and the judging proved a difficult task. Prizes were however eventually awarded to Messrs. Wyatt, Somerville, Beckett, Walker, Keirstein, Snow, Adams, and another gentleman. The prizes were presented to the successful competitors by Miss Baldwin, F.C.D., Chief Demonstrator to the Croydon Gas Company, who, in congratulating each on the success of his culinary art, presented an iced decorated cake, together with a cookery book. This brought the proceedings to a close for the time being.

A lecture was given later by one of the Gaslight and Coke Company's demonstrators on cakes and pastry; and a final lecture was delivered on Thursday afternoon at 3 p.m.

GAS AND ELECTRIC COOKING.

Slow Baking and Loss of Weight by Evaporation.

THE article in last week's "JOURNAL" on the above subject (p. 17), incorporating the results of comparative tests with gas and electric ovens made at Brighton, and kindly supplied to us, at our request, by Mr. Joseph Cash, M.Inst.C.E., have been very widely read and studied to ascertain how far they substantiate the claims of the electrical competitors of the gas-oven. There is a point about these tests that appears to indicate the influence of slow cooking upon the loss of weight by reduced evaporation, and, of course, the characteristics of the meat dealt with must also have some effect.

Looking first at No. 1 test, sirloins of beef of approximately the same weight were baked in both the electric and the gas ovens—3 lbs. 7 oz., against 3 lbs. 4 oz. The net loss of the cooked joint from the electric-oven was 7¼ oz., and that of the joint from the gas-oven 8½ oz. From start to finish, the time occupied between the heating-up of the electric-oven and the removal of the joint was 105 minutes; in the case of the gas-oven, 70 minutes. The actual time the joint was in the electric-oven was 85 minutes, which is equivalent to 24 minutes per lb.; while the joint was in the gas-oven 60 minutes, which is equivalent to 18 minutes per lb. There was only 1¼ oz. difference in the loss; but the electrically cooked joint was in the oven 6 minutes per lb. longer than the gas-cooked joint, or a total of 25 minutes longer, without reckoning the ten minutes extra time given in heating-up. The joint in the case of the electric-oven was not well cooked. There are, of course, reasons for what the electricians claim, and those reasons are being fathomed by experiment.

Let us turn to No. 5 test. Here we have practically about 4 lbs. of sirloin of beef put into each oven. Seventeen minutes longer was absorbed in the over-all time in the case of the electric-oven than in that of the gas-oven. But the time the two joints were allowed to remain in the ovens was practically identical—63 minutes for the gas-cooked joint, and 65 minutes for the electrically cooked joint, which gave approximately 16 minutes per lb. in both cases. The 16 minutes compares with 24 minutes in the case of the first test with the electric-oven—the loss during the cooking being 13 oz. in this (No. 5) test, as against 7¼ oz. during the longer cooking with a joint only 9 oz. lighter in its raw state (No. 1 test). The 16 minutes occupied in baking per lb. with the gas-cooker in No. 5 test compares with 18 minutes per lb. in No. 1 test, and the net loss was 15 oz. as against 8½ oz. in the No. 1 test, in which the raw meat was 11 oz. lighter. In the No. 5 test with the electric-cooker, the joint was not crisp upon the outside.

Now these tests go to prove that, temperature, rapidity of baking, and the characteristics of the meat, all have something to do with the question of the shrinkage or loss in the baking of meat, no matter whether an electric or a gas oven is used. It is not a question of an inevitable larger loss or shrinkage in a gas-oven than in an electric-oven, as the electrical platform orators and the Electricity Publicity Committee's publications have as a rule inferred.

The tests to which we have already alluded were made by an expert cook. Some of the tests that were published in connection with the description of Mr. Potterton's new sealed-oven cooker [see "JOURNAL," March 26] were also carried out by a well-known expert cookery lecturer and demonstrator. The one referring to ribs of beef was for example; and, in this instance, with a joint weighing 5 lb. 10½ oz., the net loss in cooking was 9½ oz. The consumption of gas in that test was only 18 cubic feet; and the joint was placed in the oven before the latter was heated-up. Reckoning from the cold state of the oven, the time occupied per pound was rather more than usual; but the small loss due to evaporation and the facts presented here point to the relation of temperature, time, and loss—no matter the heating agent employed.

We turn back again to Mr. Marks's enclosed tin for use in ordinary gas-ovens, as described in the "JOURNAL" for Jan. 9; and there are given the details of a public test on a 4 lb. 6 oz. joint—the net loss being only 6 oz. There are three million gas-cookers of the ordinary types in use in the country—the advantage of using an enclosed baking-tin in them, properly constructed for the purpose, should be spread abroad among the users of those cookers.

THE PATENT OFFICE IN 1911.

THE Twenty-Ninth Annual Report of the Comptroller-General of Patents, Designs, and Trade Marks, which covers the year 1911, and bears the signature of Mr. W. Temple Franks, contains plenty of evidence of an active time spent both by the department and by inventors.

It seems that the number of applications for patents in the period under review (29,353) was somewhat smaller than in 1910 and 1909, when the figures were respectively 30,388 and 30,603; but when compared generally with the ten years preceding it, the applications for 1911 are seen to have reached a quite satisfactory total. The applications accompanied by provisional specifications fell from 20,768 in 1910 to 19,524 last year, which was a decrease of 6 per cent.; while those accompanied by complete specifications rose from 9620 to 9829—an increase of 2·2 per cent., and the highest number on record for any one year. This made the total number of applications, as already stated, 29,353, which was a falling off of 3·4 per cent. compared with 1910. The complete specifications filed on previous provisional specifications fell from 9485 to 8833; so that the total number of complete specifications received was 18,662, as compared with 19,105 in 1910, or a decrease of 2·3 per cent. The total number of specifications (provisional and complete) received was 38,186, as compared with 39,873, which was a decrease of 4·2 per cent. The figures for the last four years have been: 1908—applications, 28,598; complete specifications filed, 17,746. 1909—30,603 and 18,705. 1910—30,388 and 19,105. 1911—29,353 and 18,662. Last year, only 598 applications were received from women inventors—an even more modest figure than the 671 of 1910. Of the applications made for patents, 18,181 were received from residents in England and Wales, 1040 from Scotland, and 338 from Ireland.

The figures for 1911 show an increase in the number of applications received from Australia, Canada, New Zealand, and the Transvaal; while as regards foreign countries there was also an increase in the applications from Austria, Belgium, Denmark, France, Germany, Italy, Russia, Spain, Sweden, Switzerland, and the Argentine Republic. The United States, on the other hand, was among the countries exhibiting a decrease. The applications from Germany numbered 3304, compared with 3221 in 1910; from the United States, 2670, against 2818; and from France, 1143, against 1075. Out of 13,452 patents sealed upon the applications made in the year 1898, 528, or 3·9 per cent., were maintained for the full period of fourteen years. The number of patents which expired in 1911 was 15,539; and the total of new patents sealed was 17,164. Therefore the number of patents in force was increased during the year by 1625.

In what directions have inventors mainly been turning their attention during the past twelve months? Locomotion, we learn, is a prominent subject; and "the internal combustion engine, an important factor in the science of locomotion, is greatly in evi-

dence—particularly in connection with the revolving-cylinder type, and the so-called 'valveless' engine, in which poppet valves are dispensed with." A considerable diminution in comparison with the previous year is shown in aeronautics; but the subject is still one of the outstanding features of the year's invention. In connection with any matter that arouses public interest to any considerable extent, it is usual to find a big crop of applications for patents; and therefore it is not surprising to see on the present occasion that marked attention has been paid to mechanism for the registration of "extras" with taxi-cabs, and to automatic appliances for the prevention of certain classes of railway accident. Activity has also been noticeable in connection with the synthetic production of india-rubber and of ammonia.

With regard to the result of the examination of the complete specifications filed upon applications made in the year 1910, it may be pointed out that 1181 of the specifications were reported as wholly anticipated, 10,352 as being partly anticipated, and 5506 as not anticipated. Of those anticipated, 10,363 were amended without a hearing taking place, and 740 after a hearing and decision. In 321 cases, a reference to a previous specification was inserted. Under the provisions which empower the Comptroller to revoke a patent upon the application, within two years from the date of the patent, of any persons who would have been entitled to oppose its grant, there were eight applications, one of which was rejected as being out of time. In one of the remaining cases the patent was revoked, in two the application was dismissed, two applications were withdrawn, and two are outstanding. The number of applications made for the revocation of patents worked exclusively or mainly outside the United Kingdom was five. In two of these cases the patent was revoked, in one the application was dismissed, in one the patent expired after the proceedings had begun, and the remaining case is still pending. Six petitions for the extension of the term of patents were lodged during 1911. Of these, four were abandoned, and the other two cases are still undecided. There are now three patents in force which have been prolonged beyond the normal period of fourteen years.

The receipts from patents fees last year were £283,204, compared with £276,904 in 1910; from designs fees, £7450, against £6410; and from trade marks fees, £15,990, against £18,292. The receipts from sales of publications amounted to £13,067—making the total receipts £319,711, as compared with £314,024 for the preceding year, or an increase of £5687. The expenditure (£204,980, against £214,955 in 1910) exhibits a decrease of £9975.

Peat as a Substitute for Coal.—In an article on "Some Impracticable Alternatives for Coal," which appeared in the Financial and Commercial Supplement to "The Times" last Tuesday, the writer referred to peat, which, in its solid form as fuel, is, he said, the only alternative to coal available in the northern regions of the earth. "Peat in its natural condition is, of course, no use as fuel. There are, however, processes in existence by which it can be dried and compacted into solid blocks suitable for use anywhere where coal, as coal, can be employed, It only requires that coal should permanently advance a modest percentage beyond its recent average prices to bring solid peat fuel into industrial and domestic use on a large scale. It is the only form of artificial fuel which could be made available on the great scale, and would have anything like the wide and varied range of application, which constitutes the immense advantage of pit coal. Hence the conclusion at which one arrives touching alternatives to coal is almost comparable with the famous chapter on 'Snakes in Iceland.' There are none. And as this article began with romance, it may appropriately end with the suggestion that long before any adequate alternative appears, we shall see a sort of revival of the great tea clipper days, and enormous sailing vessels, or oil-engine ships, or a combination of the two, using Burmese oil, bringing Chinese coal to London—a contingency, indeed, that may not be so very far off, after all."

Cleaning a Suction Well.—Some of the small things that come up in the operation of a pumping-station were discussed in a paper by Mr. M. M. Symons, the Chief Engineer of the Danville Water Company, at the recent annual meeting of the Illinois Water Supply Association. One of the things referred to was the cleaning of a suction well. In the Danville pumping-station it became necessary to clean out a brick-lined suction well, 48 feet diameter and 19 feet deep, the bottom of which is 12 feet below the river bed. There is a 20-inch cast-iron pipe extending from the river into the well, turning down just inside to the bottom, and continuing to the centre, where it discharges upwards through a 20-inch T-piece. A 13-years' deposit had accumulated to a depth of 9 feet at the wall line and 3 feet in the centre of the well; and as the pump suction is located at the side of the well the agitation caused by pumping gave considerable turbidity. It was decided, therefore, to clean the well. The suction well was shut off from service, and a pit 10 feet deep was dug on the outside of the well. A 6-inch centrifugal pump was placed in this pit, and connected with the well through a hole in the wall. This pump was belted to an ordinary threshing-engine; the suction-pipe being fitted with a swing-joint, permitting raising or lowering at will. A fire-hose under 100 lbs. pressure was used to stir up the mud, which was then pumped out by the centrifugal pump. Enough water was admitted from the river to float a raft in the well for handling the hose. At the end of three days the work was completed.

GERMAN TEXT-BOOK OF THE GAS INDUSTRY.*

THE handbook before us takes precedence in respect of comprehensiveness and worth of any work dealing with the gas industry which has been published during recent years in the German language—perhaps, indeed, in any language. It is free from irrelevant observations and padding, and nearly every item of the subject-matter is dealt with in a masterly and thorough manner. The author, generally speaking, appears to be well abreast of English and Continental practice and research, and so at once puts his work on a higher plane than any other modern German publication on gas manufacture of which we are aware.

Dr. Bertelsmann is, we believe, on the technical staff at the Tegel works of the Berlin Corporation gas undertaking, and has, therefore, had ample opportunity of studying the operations of gas manufacture on a large scale, as well as of profiting from the large amount of experimental work and investigations carried out there. But he must have studied assiduously also the reports of progress elsewhere. His introductory note bears evidence that he has gone fully into the early history of gas supply and gas lighting in different countries; and the epitome of it which he presents is well arranged and sufficiently nearly exhaustive.

The first chapter of the work deals with the raw materials of gas manufacture, and its first section with coal. After referring to the origin and distribution of coal and its classification, the author passes on quickly to its examination. He recommends that the sampling of a consignment should be carried out at some point on the conveyor or telpher-line by which the coal is carried to the store or the retort-house. By this course, a fair average sample is obtained ready to be broken-down and quartered in the usual way to provide the final samples for testing in experimental plant and in the laboratory. The only method for the determination of moisture in coal which is described is that of drying a weighed portion at 105° C., though in a book of this calibre we should have expected to find the method of drying *in vacuo*, and other methods of greater refinement mentioned. The methods given for the determination of ash, volatile matter, and sulphur are those largely in vogue in German gas-works laboratories. We think the author would have done better to have described the exact procedure in each case recommended by the Committee of the American Chemical Society; since their prescriptions have received almost international recognition. Scant sympathy is shown towards coal-testing in the small retorts which take a charge of about one-thousandth of a ton, for they are rightly said to give fallacious results; while large-scale tests are commended as a means of ascertaining the best conditions of carbonization for different grades of coal.

The author then passes on to describe machinery for the handling and transport of coal, the construction and equipment of coal storage-houses, and the disposition of conveying plant, &c., for storage in the open. He discusses the causes of spontaneous ignition of coal, the best means of avoiding it, and the loss of gas-making value which ensues on prolonged storage. Finally, he mentions the advantages of storage under water, as adopted by the Western Electric Lighting Company of Chicago. The next raw material referred to—viz., gas oil—is dealt with more satisfactorily than in other German text-books. The author gives very little space to the oils produced in Germany by the distillation of shale and brown coal, because virtually the whole supply of these oils is already appropriated for other special uses. For carburetting water gas in Germany (as here) only imported petroleum practically comes into account. But Herr Bertelsmann is the first German writer on the subject, so far as we are aware, who has at once admitted the absurdity of considering the native oils as of any real utility for the manufacture of carburetted water gas. Oil which has a specific gravity lying between ·83 and ·88 may now be imported into Germany for use in gas making at a lower scale of duty than other oil. Benzol is more largely used for carburetting (without the application of heat) water gas and mixed gas in Germany than here; but, on the other hand, petroleum spirit or carburine has scarcely ever been used for similar purposes there—doubtless because of the heavy import duty exacted on it.

The second chapter of the work covers the production of the crude gas, and is divided into two sections—one on coal gas, and one on water gas. The influence of temperature on the products of the carbonization of coal is discussed exhaustively with the aid of several diagrams. The heat balance of carbonization is dealt with in the light of the researches of Mahler, Poole, and Constam and Kolbe; but the author appears to have overlooked the instructive investigations made on somewhat different lines by Euchêne. The testing of materials for the construction of retort-settings, and the principles underlying the use of producers and regenerative furnaces are handled very satisfactorily. Good sectional diagrams of various types of settings of horizontal retorts are given. But they all refer to "singles;" and throughout the book the author makes only the barest mention of 20-feet "through" retorts and methods of operating them. Presumably this is owing to there being only two or three modern installations

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* "Lehrbuch der Leuchtgasindustrie;" von Dr. Wilhelm Bertelsmann, Diplomingenieur. Two volumes: Vol. I., "Die Erzeugung des Leuchtgases," with 12 plates and 401 illustrations; Vol. II., "Die Verwendung des Leuchtgases," with 308 illustrations and 49 tables. Ferdinand Enke, Stuttgart. 1911.

of such retorts in Germany. Diagrams and descriptions of settings of inclined retorts and of the Dessau system of vertical retorts follow; and then under the heading of large chamber carbonizers, the Munich inclined chamber settings are described, and a large sectional diagram is given. Mention is made of other types of vertical retorts and of horizontal carbonizing chambers.

The author proceeds to the retort-house and its equipment, in connection with which large sectional diagrams are used by way of showing typical modern designs. The control of heats and of the general working of the carbonizing plant is very well handled; and the section on coal gas production concludes with notes on the scurfing of retorts and the clearing of ascension-pipes. The ensuing section treats of the manufacture of water gas, both simple and carburetted, more thoroughly than is usual in German handbooks. Several types of plant are described, including, of course, the Humphreys and Glasgow form, as made by their German colleagues Messrs. Julius Pintsch.

The third chapter of the book relates to purification—in its widest sense, including condensation, exhausting, tar extraction, naphthalene removal, cyanogen recovery, washing-scrubbing, and oxide purification. The hydraulic main is regarded as the first item in the condensing plant, and is dealt with very fully. The author advocates the use of atmospheric condensers on a liberal scale, leaving only the final condensation to be effected by means of water-cooled condensers. He recommends Perrissini's formula for calculating the surface area of the atmospheric condensers—viz., 9·1 square feet of cooling surface per 1000 cubic feet of gas made per 24 hours. Piston exhausters are more common in Germany than here; and an account of them precedes that of the rotary or Beale type. Roots' blowers are, however, now in use at some German works. A sectional elevation is given of the Rateau compressor making 4000 revolutions, which is driven by a Laval steam turbine making 20,000 revolutions, as installed at the Charlottenburg gas-works. The Pelouze tar extractor, with either the single or the double walled bell, is the only tar extracting apparatus described. The removal of naphthalene by "warm condensation," by oil-washing, and by oil-fog or spirit spraying, is treated fairly exhaustively—especially the oil-washing process, which though due, as the author points out, in the first instance to Messrs. Young and Glover, has been much more widely used in Germany than in this country. Rutten's modification of the picric acid method of Colman and Smith is recommended for the determination of naphthalene in coal gas. Cyanogen recovery is very well handled by the author. He is apparently, however, not aware that the process of washing gas, before the removal of the ammonia and sulphuretted hydrogen from it, by a solution of ferrous sulphate, was carried out on a large scale in a London gas-works for some two years before Dr. Bueb independently conceived it. The section of the chapter in which the ordinary washing of gas for the extraction of ammonia is dealt with makes very good reading, and several typical scrubbers and washer-scrubbers are described. Finally, the direct production of sulphate by washing with acid is noticed; and the Koppers' plant for the purpose is shown.

The author then passes on to deal with purification in the more restricted sense in which that word is applied in the gas industry in England. Oxide of iron in one or other of its modifications or combinations is naturally the only material considered at length, though the author refers to the extended use of lime in some parts of this country. He gives some very interesting complete analyses of bog oxide, after fouling and revivification three, six, nine, and eleven times at the Berlin gas-works. The removal of carbon bisulphide by means of sulphided lime is described, and several of the fanciful and, on the working scale, totally impracticable schemes put forward by some modern chemists for the same purpose are mentioned. But, as a fact, sulphur compounds other than sulphuretted hydrogen are never extracted from gas made in Germany. The bulk of the coal carbonized on most German gas-works does not, however, produce gas so rich in carbon bisulphide as do most English gas coals. Different types of purifying vessels and grids are described; and there is a good account of the composition and nature of various natural hydrated oxides and artificial purifying materials. Irish bog oxide and Weldon mud do not, however, find extended notice. After treating of the examination of spent oxide, the author describes the Burkheiser process for the simultaneous extraction of ammonia and sulphuretted hydrogen.

The fourth chapter is headed "Purified Gas," and it is interesting to note the range in respect of quality and degree of purity which the author, writing from the German standpoint, regards as permissible in coal gas or mixed gas intended for a public supply. The limits he mentions are: Specific gravity from ·35 to ·48; gross calorific power, 500 to 625 B.Th.U. per cubic foot; illuminating power, 10 to 20 Hefners (say 9 to 18 candles); organic sulphur, 4 to 44 grains and upwards per 100 cubic feet; cyanogen 4 to 9 grains per 100 cubic feet; ammonia 0·04 to 0·4 grain per 100 cubic feet; and freedom from tar and sulphuretted hydrogen. This chapter is largely analytical. Experimental meters are described; and Junkers' "litre" adaptation of Harcourt's $\frac{1}{10}$ cubic foot measure for proving meters is shown. The Junkers apparatus has, however, the fault of being so small that the glass measure has to be discharged thrice for one revolution of the drum of the ordinary size of experimental meter. The degree of accuracy of its use in proving such meters is, therefore, much lower than that of Harcourt's measure. The chapter concludes with an account of gasholder design and construction.

Chapter V. relates to gas supply and distribution. It opens with descriptions of station governors and control valves, and goes on to the sizes of mains, and the formulæ for determining them. Diagrams are given based on Niemann's modification of Pole's formula for ascertaining the requisite diameters of mains. Standard sizes of pipes and unions are stated, and there is a useful account of main-laying. In connection with unaccounted-for gas, the author discusses the destruction of pipes by vagrant electric currents. A fairly long section on high-pressure mains for the supply of districts at a long distance from the gas-works follows; and the chapter concludes with a section on house connections, consumers' meters, and services.

The sixth chapter refers to the bye-products of gas manufacture, which are dealt with in the following order: Coke, coal tar, water-gas tar, ammonia, cyanogen, naphthalene, and sulphur. There are many points of interest in the author's treatment of this chapter—such as his account of the manufacture of coke-breeze briquettes, the use of centrifugal machines for dehydrating tar, &c. The Burmeister and Wain tar centrifugal, which is more widely used on the Continent than here, is stated to make 2000 revolutions per minute, and, requiring 4-horse power to drive it, to dehydrate 2200 gallons of tar in ten hours. The water remaining in the tar after treatment is not more than one per cent. The method of using tar for the surfacing of roadways described by the author has some peculiar features, of which we have not previously heard either here or in Germany. After sweeping, the road surface is, he says, sprinkled with light tar oil, at the rate of $2\frac{1}{2}$ lbs. per square yard, and then with tar at the temperature of 180° to 210° Fahr., at the same rate—*i.e.*, about $\frac{1}{2}$ gallon of tar per square yard of surface. The author deals exceptionally fully with the working-up of gas liquor to sulphate and other ammonia products. He then goes on to the working-up of the sludge from cyanogen washers—a matter which we do not remember to have seen treated at all adequately in text-books hitherto.

The seventh (and last) chapter of the first volume relates to substitutes for, or alternatives to, coal gas—viz., acetylene, oil-gas, and air gas. The information on the first of these gases is mainly taken from Caro and a few other well-known authorities, and is quite trustworthy, though in places a little out of date. Plant for the manufacture and compression of oil gas is described in detail, but chiefly with reference to the gasification of the relatively poor Thuringian and Messel gas oils. The air-gas plants referred to are intended for the production of a moderately rich gas—*i.e.*, one containing upwards of 8 per cent. of hydrocarbon vapour, and not for the so-called non-explosive gas which has been largely exploited in this country in recent years.

The second volume of the work, which is devoted to the application or use of gas, is divided into two main portions—one relating to lighting, the other to cooking and heating by gas. These are followed by a final chapter on the Importance of the Gas Industry of Germany. There is also an introductory note on the nature and properties of the flames of gases. In the section on lighting, the materials employed in the manufacture of mantles are dealt with very fully; and the differences in the physical qualities of the various fibres used are well shown by a large number of illustrations. Typical upright gas-burners are then described, and the distribution of light therefrom, and the effect of screens, &c., on it, are discussed. Fittings and lanterns for use with upright burners, both for high and low pressure gas, are also considered. The author then proceeds to deal with the inverted burner, for gas both at ordinary and at high-pressure, and with fittings and appliances for use with it. Drehschmidt's and some other devices for determining the illuminating power at different angles are described. Then there is a section on the compression of gas, followed by one on distant igniting and extinguishing apparatus for street-lamps, &c. After an account of the chief types of acetylene burners, the author discusses exhaustively the laws of illumination, and shows, by the aid of many diagrams, the distribution of the illumination of pavements from various kinds of gas-lamps, at different heights and different distances apart. Street photometers are then dealt with; and a section on the hygienic aspects of incandescent gas lighting concludes the portion of the volume on "Lighting."

Cooking and heating by gas are not so satisfactorily handled by the author as are the other branches of his subject-matter. Practically nothing is said about the English type of gas-fire; and no doubt Mr. Körting's recent article on the relative efficiency of it and the reflector stove which is popular in Germany will have indicated to the author that he has failed to take proper note of the technical advances which have been made in this direction outside his own country. Neither are gas-steam radiators at all adequately treated by him. In regard to the industrial uses of gas also he seems to have restricted his acquaintance to German apparatus, which, in many cases, is considerably inferior in efficiency and utility to British.

It has been impossible to criticize in detail so comprehensive a work as that of Dr. Bertelsmann in the limits of the space at our disposal. It has limitations and faults, of which we have given some indication; but it stands withal as a treatise which everyone connected with the gas industry, who has mastered the German language, may consult with the assurance that he will thereby gain some sound and valuable information. Not the least valuable feature of the work is the comprehensive bibliography with which the author concludes each section—the references being both to text-books and to articles in technical periodicals relating to the subject dealt with in the section.

THE METROPOLITAN GAS COMPANIES' ACCOUNTS.

For the Years 1910 and 1911.

—	Year ended Dec. 31, 1910.		Year ended Dec. 31, 1911.	
	Totals.	Per 1000 Cubic Feet of Gas Sold.	Totals.	Per 1000 Cubic Feet of Gas Sold.
	£ s. d.	s. d.	£ s. d.	s. d.
Capital and borrowed money (including premium capital) . .	40,158,151 2 8	19 7·82	40,142,763 2 0	19 4·80
Income—viz.:				
Gas rental	4,988,983 12 3	2 5·30	4,932,271 4 4	2 4·61
Rental of meters	243,195 19 2	1·43	252,328 14 9	1·47
Rental of stoves, fittings, &c.	386,815 1 11	2·27	411,171 3 9	2·39
Residual products—				
Coke and breeze	971,772 7 0	5·71	1,083,266 10 10	6·28
Tar and tar products	191,592 19 9	1·13	226,588 12 7	1·31
Ammoniacal liquor and sulphate of ammonia	346,300 19 11	2·03	378,110 15 11	2·19
Miscellaneous, including old materials	41,546 9 11	0·24	36,858 11 1	0·21
Total income from all sources	7,170,207 9 11	3 6·11	7,320,595 13 3	3 6·46
Expenditure—viz.:				
Coal and oil, including carriage and dues; also coke and breeze used for making carburetted water gas	2,135,386 16 9	1 0·54	2,135,282 8 3	1 0·39
Salaries of engineers and officers at works	65,775 15 6	0·39	68,835 16 0	0·40
Wages—manufacture	307,535 17 5	1·80	316,185 17 1	1·83
Purification	55,911 6 1	0·33	83,225 18 8	0·48
Wear and tear—manufacture	735,012 0 9	4·32	778,328 15 2	4·51
Salaries and wages—distribution	154,867 10 6	0·91	161,733 14 2	0 94
Repair and maintenance of mains and services	252,143 0 6	1·48	261,867 3 11	1·52
Repair and renewal of meters, stoves, &c.	635,146 13 9	3·73	642,391 17 6	3·73
Lighting and repairing public lamps	66,110 3 0	0·39	67,609 1 5	0·39
Rents, rates, and taxes	432,246 2 11	2·54	471,324 12 6	2·73
Salaries—management	29,371 13 4	0·17	30,581 12 0	0·18
Collectors' salaries and commission	91,993 10 6	0·54	92,650 15 9	0·54
Stationery, printing, and general charges	56,711 8 10	0·33	58,939 19 1	0·34
Directors and auditors	16,711 17 10	0·10	16,547 19 5	0·10
Co-partnership and profit-sharing schemes	76,065 4 10	0·45	84,473 0 3	0·49
Annuities to officers and workmen	85,828 6 10	0·50	75,421 18 10	0·44
Law and parliamentary charges	12,178 4 5	0·07	7,731 1 9	0·04
Bad debts and extraordinary expenses	28,843 17 11	0·17	29,551 14 0	0·17
Total expenditure on revenue account	5,237,839 11 8	2 6·76	5,382,683 5 9	2 7·22
Gross profit	1,932,367 18 3	11·35	1,937,912 7 6	11·24
Do. per cent. on capital and borrowed money	4 16 3	..	4 16 6	..
Do. do. gas-rental	38 14 8	..	39 5 10	..

UTILIZING UNMINED COAL FOR THE PRODUCTION OF GAS.

An American Patent.

ATTENTION has recently been directed to the proposal to utilize coal seams *in situ* for the production of gas that may be brought to the surface and piped away to suitable points of combustion. Such a project was described in a patent taken out in this country in 1909 by an American citizen—Mr. Anson Gardner Betts, of Troy, New York State; and it may be of interest at this time to state what he claimed as his invention.

He says his invention relates to a method of utilizing the coal measures and coal remaining in worked-out mines, so as "to provide for the utilization of coal-seams too thin or too poor for commercial use by present methods."

The specification proceeds: "It is well known that coal may be 'gasified'—that is, converted into combustible gases—by combustion with insufficient air for complete combustion; and if the right proportion of steam or water be used with the air, the coal can be gasified without causing an excessively high temperature in the coal or in the escaping gases, and the gas may be made so that it is capable of producing as much as 80 per cent. of the total heat that would be produced by the coal. All that it is then necessary to do is to mix it with the proper amount of air for complete combustion. Such gases are a more valuable and convenient fuel than the coal from which they are produced, and are especially suitable for running gas-engines. The great advantage of gas over coal lies in its easy transportation to where it is used; and it produces no ashes, besides all which an even heat can be maintained without attention." The present proposal therefore is "to gasify, under heat, the coal where it lies underground by supplying an oxidizing gas thereto."

To carry out the invention, he says two shafts, or a shaft and bore-hole, may be provided in the coal seam, and an air-passage through the seam provided, either by driving from one shaft to the other or from the shaft to the bore-hole, which, if not already existing, is sunk to the workings. A fire is started at the bottom of one shaft and a supply of air pumped down and water or steam also supplied, when gas analogous to producer gas comes out of the other shaft, and can be used for running gas-engines, &c. The tar and ammonia produced can be collected in any suitable way.

The invention contemplates the use of several different drifts in the coal with separate air supplies; so that the combustion rate may be regulated by the use of just the right number of fires to give the best results, as well as the use of crooked fire passages—*i.e.*, passages which extend irregularly through the seam so as to increase the area of the coal exposed, both of which will aid in completely burning-out a given area.

The advantage of several holes to the surface through which the gases may be drawn out is apparent. If air-cracks allow air to come in near a gas outlet and too much free oxygen comes out in the gas, by operating another gas outlet at a greater distance from the air inflow obviously a greater degree of combustion may be obtained.

As the removal of coal from an area may cause subsidence and open cracks through which the valuable gases may escape to the surface of the ground and be lost, the invention contemplates (when desirable) the use of at any rate a slight suction at the gas outlet, in order rather to draw air in through such cracks than to force gas out through them. The subsidence is useful, however, in that it tends to fill the space left vacant where the coal has been burned out, except near the face of the coal, which circumstance causes a large part of the air to pass near the face of the coal.

Other methods of carrying out the invention may be employed, in which it is required only to use one bore-hole to the coal. After the bore-hole is completed, a pipe is let down to the coal through the bore-hole for a supply of air; the coal ignited; and thereafter a current of air forced in, and gas taken out. After so large an area is burned out that the action is not satisfactory, another bore-hole may be let down to near the edge of the burned area, through which air is supplied thereafter instead of through the first-mentioned means, until that, too, ceases to work well, when other holes may be put down.

Another method consists in sinking a shaft nearly down to the coal, or beyond, and drifting from the shaft, either above the coal or (better) below it, and boring air holes to the coal from the drift, where they are required. The gas produced in this method to be drawn or forced preferably to the surface through a bore-hole or another shaft.

It is obvious that if air without water or steam is used to gasify the coal, intensely high temperatures may be obtained—sufficient to fuse some rocks; and in this way the patentee contemplates being able to melt rock down to fill up burnt-out spaces, and form pillars to support the ground, so that the subsidence or caving that occurs with the removal of the coal need not extend to a sufficient height above the workings to make open cracks to

the surface for the escape of gas, or at least to prevent it to a large extent.

For the greatest economy of fuel in making gas, water should be brought to the burning coal as well as air. If sufficient water is not supplied by natural agencies, it may be passed in the gaseous state with the air supply. When water is supplied with the air, it is decomposed by hot carbon, with the formation of combustible gases, increasing yet considerably the value of the gas as a heat-producing medium. "Such gases are very valuable for many purposes, although not as rich as natural gas."

To produce gases having higher heating values (more like natural gas), the patentee would proceed in the following way: The hot gases, from the gasification of the coal, on passing through or near a good deal more coal, will heat this coal, and tend to coke it, producing large quantities of a rich gas, mixed with the heating gas. After this coal gets well baked, it will not be possible to get these rich gases in quantity any more from the particular coal; but by operating a number of subterranean fires in different stages of completion, several qualities of gas may be obtained and applied to such various uses as they may be especially economical for.

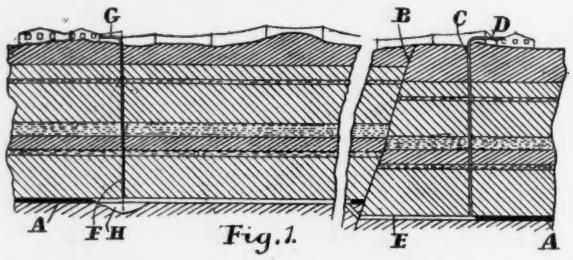


Fig. 1.

In fig. 1, the patentee shows a coal seam A, faulted at B. Air forced down the shaft C, by pumps (not shown), goes through the pipe D, which is connected to the shaft, then through the shaft and passage E, cut in the coal, to the shaft F, whence the resulting gas passes to the surface by the pipe G. The well H collects tar, which may be pumped out through a pipe let down the shaft.

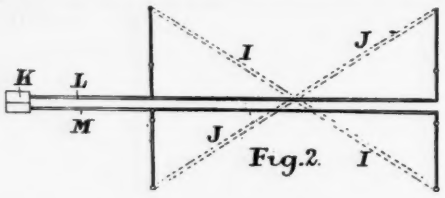


Fig. 2.

In fig. 2 (a plan) are shown four shafts driven to the coal seam, and drifts I J connecting the bottom of them. The plant-house K may contain electric generating machinery driven by gas-engines, and consume the gas produced, or the gas may be pumped to distant points for consumption. The plant also supplies air through the air-pipe L to the shafts, and the gas generated underground is delivered to the power plant by the pipe M. There are, of course, valves to regulate the direction of the air and gaseous current underground.

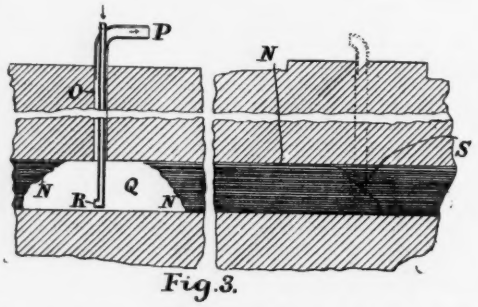


Fig. 3.

In fig. 3 is shown a coal seam N, reached by the bore-hole O, down which have been passed an air and steam pipe; while the top of the bore-hole is provided with a delivery pipe P for gas. The opening Q is due to the gasification of the coal, and widens continually as the coal is gasified—a side air-jet R being provided to blow the air towards the coal. After the opening gets too large for successful action, and reaches the line S, another bore-hole would be drilled, and thereafter air and steam passed down one and gas taken out of the other.

In fig. 4 is shown a coal seam reached from the surface by a bore-hole (as usual), and from the lower drift by several bore-holes—driven at different periods, according to the position of the face of the coal at the time. Air and steam for gasification are supplied through the working T of the bore-holes, according to the circumstances; the gasification of the coal taking place in the seam, while the useful gases go to the surface.

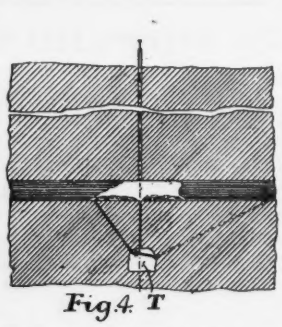


Fig. 4. T

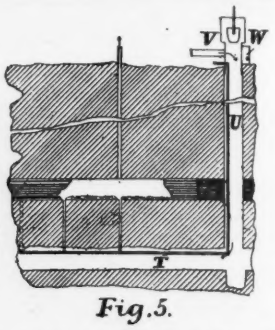


Fig. 5.

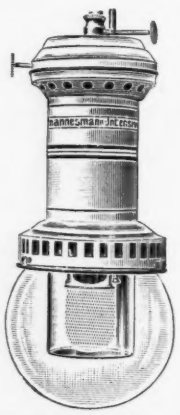
Fig. 5 is a section of fig. 4, and shows, in addition to the drift T, the air and steam supply holes and the pipes for air and steam or water supply. The drift is reached by the shaft U, the top of which is enclosed with a building, with an air supply pipe V. On closing the door W, air passes down the shaft, and is delivered to the coal through the bore-holes.

The patentee claims: 1. The process of utilizing unmined coal which consists in supplying oxidizing gas thereto, gasifying the coal under heat, and utilizing the gas produced. 2. The process of utilizing coal seams, which consists in forming a passage to the coal in the same, supplying oxidizing gas to the coal through such passage and causing the gas to pass through a plurality of passages in the coal, to gasify the coal under heat, and withdrawing the gas produced thereby. 3. The process of working unmined coal, which consists in supplying oxidizing gas thereto, gasifying the coal under heat, and removing the gas at a less pressure than atmospheric pressure at the level of the gas outlet from the coal.

MANNESMANN "INTENSIV" GAS-LAMP.

A NEW low-pressure high-power lamp has been introduced to notice by Messrs. J. & W. B. Smith, of 17-23, Farringdon Road, E.C. It is a small gas-lamp with a large illuminating power and effect; and combined with the fact that it is a lamp with a good external appearance, it will be at once appreciated that it is one for adoption where, for interior purposes, a medium high-power unit is required—for instance, in shops, restaurants, factories, and other places too numerous to refer to. It is known as the Mannesmann "Intensiv" lamp; and at present only one size is made. The consumption is 7 cubic feet per hour; and although a low-pressure lamp, the candle power on what is now about the normal gas supply in London and the south is said to be 300 candles. This represents a remarkably high efficiency; but whether the named illuminating power is actual, we are satisfied from mere visual test with the efficiency of the lamp.

There are various points about the lamp which contribute to this result. In the first place, the gas-injector is provided with a needle-regulator; but the regulation of the primary air supply is quite out of the ordinary. The velocity of the discharge of gas into the bunsen tube is made the regulator for the induction of the primary air. The air apertures are fixed; but leading from the inside of the bunsen tube just by the air inlets to outside the lamp is a screw, which, turned so as to project inside the tube comes right across the pathway of the inflowing gas, and so checks the velocity of its flow—the farther in the screw projects, the greater the check; the farther it is withdrawn, the greater the velocity of the gas. Thus as the velocity of the gas is diminished or increased, so is the primary air drawn in reduced or augmented. It is particularly interesting to notice how rapidly the alteration of the light and the incandescence of the mantle respond to this process of air-regulation. Another contribution to the high illuminating power is no doubt the fact that the air for the primary supply is drawn from the outside of the lamp into a channel round the heated head, and from this channel it is led by cross ducts to the air-inlets of the bunsen tube. In this way it is heated before mixing with the gas. The secondary air supply passes in through apertures in the casing above the globe, which has no opening; while around the mantle is a long inner cylinder which connects with the chimney for the products of combustion. Thus no cold air obtains access to the gas, the flame, or the mantle; and the accelerating influence of the sharp upward current of air over the mantle also helps to promote its incandescence.


Mannesmann "Intensiv" Gas-Lamp.

These are all the vital points about the new indoor lamp, which points explain the contributory sources of efficiency. Other features about the construction are that the casing is a strong one, cream enamelled with gold relief. The bunsen is fitted with a heavy magnesia nozzle which supports the mantle. The channel for the products of combustion has at the top two openings, with deflectors, so that the products are discharged laterally.

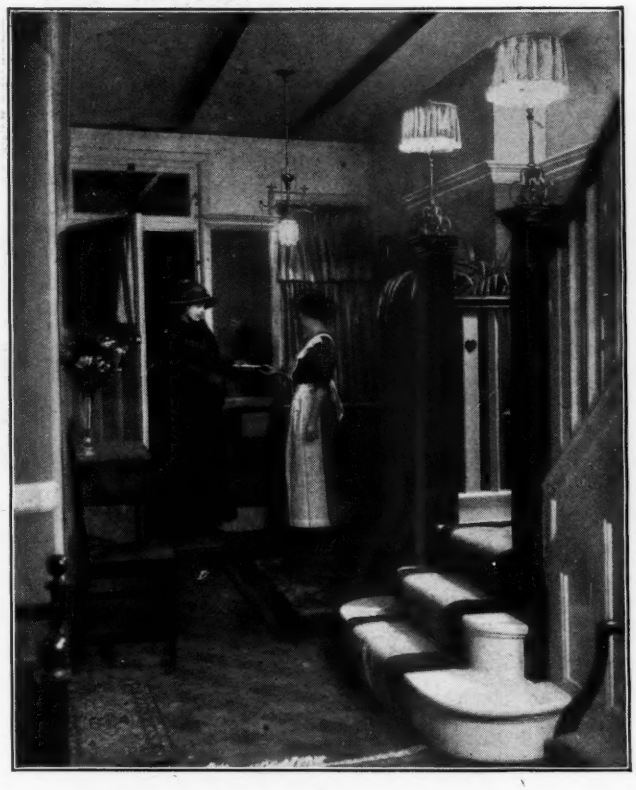
SOUTH METROPOLITAN COMPANY'S GAS SHOW-HOUSES.

New and Attractive House in Telford Park, Streatham Hill.

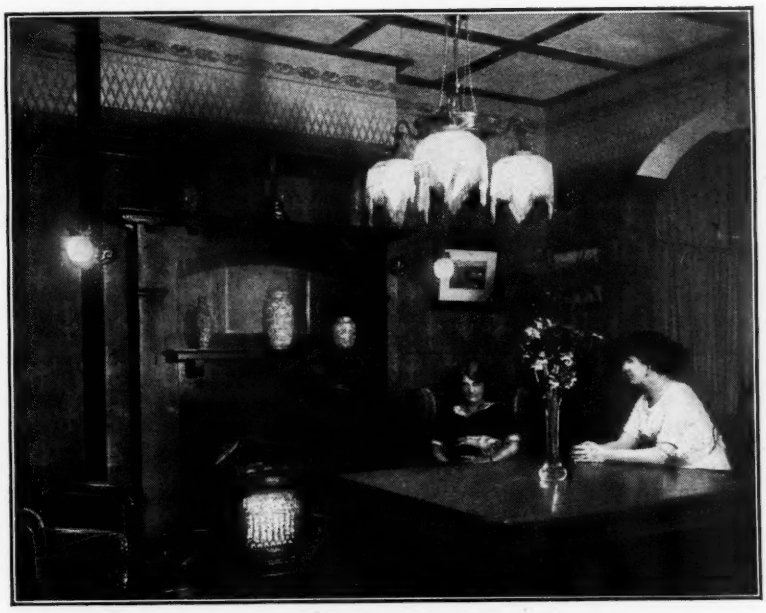
In the "Journal" for Aug. 10, 1909 (p. 374), a description was given of a furnished house at Catford, which was lighted and heated by the South Metropolitan Gas Company, to show what could be done by gas in the directions named. A similar house has now been opened at Telford Park, Streatham Hill; and some of the general arrangements are shown in the accompanying illustrations. They are self-explanatory; but a few details of the place may be given.

The house has been fitted up with excellent taste. On the right of the hall is the dining-room, furnished in oak, and lighted by a three-light oxidized copper pendant, carrying three "Metro" burners with silk shades of the handkerchief pattern. These burners are used throughout the house, and the gas supply to them is ignited by pneumatic switches placed near the doors of the rooms. On the mantelpiece are two lights connected with the switch. The gas-fire is controlled by a standard tap at the side of the easy-chair. In the drawing-room, which is a fine apartment, the gas-fittings are oxidized silver pendants with three bead-shaded burners. There is also a standard lamp with old rose drapery. Oxidized silver brackets are on either side of the artistic fire, which, like the gas-fire in the dining-room, is fitted with a standard tap. The "afternoon tea" ring in this apartment is a novelty; the hostess having simply to turn on the gas and boil the water without troubling the domestics.

The upper rooms are reached by a broad staircase, the newel posts of which are decorated with two very fine gas-lamps. The main front bedroom, with its square windows and handsome furniture, is fitted with a convenient lamp over the bed for reading purposes, a gas-fire for warming it within a few minutes of dressing, a gas-ring for heating shaving water or children's food, and an ingenious gas-heated hair-curling tongs arranged beside the washstand. The bathroom is fitted with a geyser, which gives an immediate supply of hot water. Attached to it is a patent tap which admits the gas as the water is turned on; so that the supply of gas is in exact proportion to the quantity of water heated.



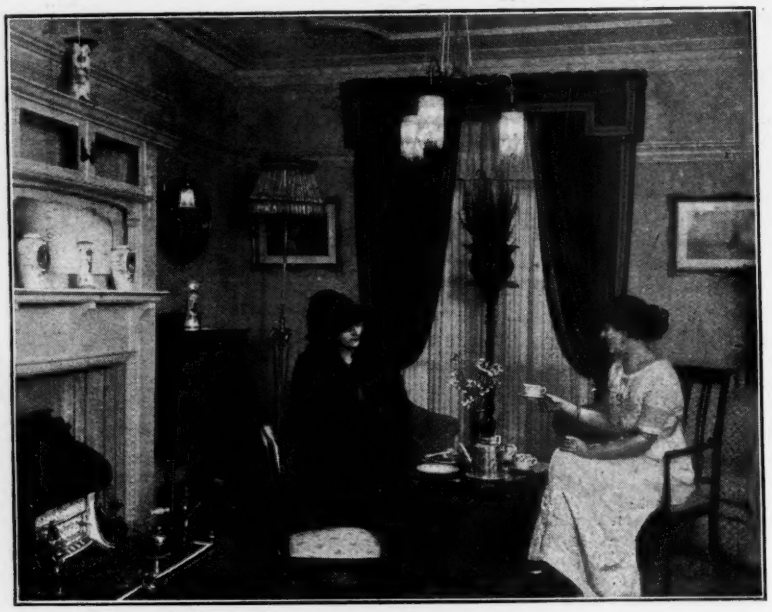
A Cheerful Hall.



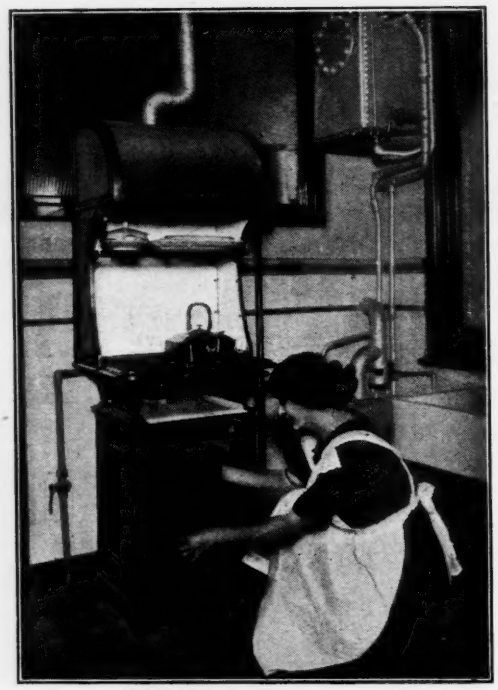
Adaptability for the Dining Room.

The kitchen contains a combination gas and coal range fitted with a high-pressure boiler, and also a gas-heated boiler. Both are connected with the pipes supplying the house with hot water; and they may be used either in conjunction with, or independently of, each other. The great convenience of the combination range scarcely needs emphasizing. If the fire is kept up in the kitchen in the winter for the convenience of the cook, the gas hot-plates can be moved aside, and the appliance used as an ordinary coal-range. When, however, the heat of the open fire would make the kitchen unbearably hot, the hot-plates can be turned down, and the range used as a gas-stove. The ovens can be heated either by gas-burners attached or by a coal-fire. The other kitchen furnishings include a gas-heated coffee-roaster and a hot-water circulator. The latter occupies very little space, and will heat all the water required in the house. Like the gas-boiler, it can be used either with or apart from the range. In the scullery, there is a gas-stove fitted with a hood, enamelled inside, which conveys away all the steam, and contains a shelf for warming plates. In one corner is a circulating boiler, and in another a gas-heated copper. There is also a gas-heated clothes airer.

The illustrations we give show how attractive a house can be made, and how well gas can be utilized in it for lighting, cooking,



A Caller's Welcome.



Advantages in Cooking.

Comfort in the Scullery.

and household purposes generally. Before concluding, just a few particulars may be given as to the cost of lighting. As mentioned at the outset, the "Metro" burner is used throughout the house. A medium-sized burner of this type gives the light of at least 50 candles with a consumption of 2½ cubic feet of gas; so that 40 cubic feet, costing 1d., will keep the burner going for 16 hours. Comparing this with electric lighting at 3½d. per unit, a pennyworth of current would supply a lamp of similar power for only five hours—showing that this system of lighting is three times more costly than gas.

Movement towards Realizing Professor Ramsay's "Dream."

It will be remembered that in the course of his remarks on the occasion of the opening of the Smoke Abatement Exhibition on the 23rd ult., as reported last week (p. 863), Sir William Ramsay surprised his hearers by expressing the belief that the time would come when, instead of sinking coal shafts, engineers would bore into the coalfields and drive concentric pipes. Down one they would pump air to carbonize the coal (or, if water gas were wanted, steam), and from the other gas would be drawn, which would be used at the pit's mouth for actuating gas-engines. Dynamos driven by these engines would furnish high-tension current, which would be distributed over the country by cables. It now appears that Sir William was not talking as a visionary of a condition of things which might be expected to exist in the dim and distant future, but of a scheme capable of realization within our own times; for, according to a statement which has been freely circulated, he has made arrangements with a large colliery proprietor for carrying out an experiment on a small scale, on the lines suggested, during the coming summer. In an interview with a representative of the "Pall Mall Gazette," Sir William claimed among the advantages of his proposal that electric power for railways and industries could be generated at one-fifth—probably at one-tenth—the present cost, and that domestic lighting and heating could be done at a fraction of the price which has now to be paid. The saving of fuel thus effected would, he considers, prolong almost indefinitely the life of the coalfields, and get rid of the miners, whose place would be taken by skilled mechanics. The learned Professor has, as he said, "dreamed a dream." The scientific and the industrial world—especially the latter—will watch with keen interest for an announcement of its realization.

STUDIES IN CARBONIZING.

III.—INVESTIGATIONS IN CANDLE AND CALORIFIC VALUES AND RESIDUAL PRODUCTS.

By Dr. W. B. Davidson, of Birmingham.

In considering the make of gas per ton of coal, we must, of course, pay due regard to statutory quality, whether it be candle power only, calorific value only, or a dual standard; and we therefore assess the value of gas yield, not merely by volume, not even by the volume of genuine coal gas, but by the product either of make and candle power, or make and calorific value, or the combined product of make, candle power, and calorific value.

Yield of Gas.

The quality of the gas produced by normal working of the carbonizing plants under comparison should be within reasonable limits. If, for example, the accepted standard is 15 candles, and the quality produced is actually 18, there is obvious wastage. If, on the other hand, the calorific value of the gas made is only 460 B.Th.U., whereas a value of 500 B.Th.U. is deemed necessary to meet the wants of consumers, the gas will be unsuitable.

Now, in reducing the quality from 18 to 15 candles by the ordinary method of introducing (from furnace or atmosphere) the inert gases, nitrogen, carbon dioxide, and oxygen, a large loss of sperm value or candle power multiple is entailed, owing to the well-known fact that these diluents do not lower the illuminating power *pro ratâ*, but to a much greater extent—namely, about 2½ per cent. for each unit (per cent.) of nitrogen or oxygen, and 3½ per cent. for each unit of carbon dioxide introduced; the result being a net loss in sperm value of 1½ per cent. for each unit of nitrogen or oxygen, and of 2½ per cent. for each unit of carbon dioxide added.

These figures probably apply only within certain limits. The calorific value multiple is not affected by dilution in this way. The product of make and heating power is (theoretically) constant, no matter what amount of incombustible gases may be present. It must be here noted, however, that the self-imposed penalty inflicted by "over-pulling" is, as regards sperm value, less severe with the No. 1 argand than it is with the No. 2; while the total number of heat units extracted from the coal by distillation is actually appreciably increased thereby. The latter effect is undoubtedly due in chief measure to the diminution of pressure in the retorts, and the consequent reduction of the quantity of gas passing into the furnace or atmosphere; but it may also be partly accounted for by the increased carrying power of the gas for benzene and other heavy hydrocarbons. The following typical examples illustrate the effects referred to:—

TABLE I.

Horizontal Retorts, Coal-Test Plant.

—	Make per Ton.	I.P. No. 1.	I.P. No. 2.	I.P. Multiple. No. 1.	I.P. Multiple. No. 2.	C.V. Net.	C.V. Multiple.	CO_2.	N.
	Cubic Feet.							Per Cent.	Per Cent.
1.—Ordinary working.	11,400	15·65	17·60	178·4	200·6	539	6140	2·0	8(?)
Overpulling	12,400	13·75	14·82	170·5	183·8	501	6210	3·0	13·2
Difference, per cent.. . . .	..	..	..	− 4·4	− 8·4	..	+ 1·1	..	..
2.—Ordinary working.	12,290	15·30	17·90	188·0	220·0	529	6500	2·2	8·8
Overpulling	12,590	14·50	15·85	182·6	199·6	523	6590	2·4	11·2
Difference, per cent.. . . .	..	..	..	− 2·9	− 9·3	..	+ 1·4	..	..

Illuminating Power Tests.

Seeing that gas undertakings have candle-power standards to maintain (and, in my opinion, such standards are necessary in the interests of the buyer, so long as over 10 per cent. of the gas is consumed with flat-flames), the old question, What is a suitable standard? must be answered before we can pronounce judgment on the gas produced by vertical retorts. Is vertical-retort gas made from common coal sufficiently good in candle power? Many undertakings are still compelled to test gas supplied to their respective districts with the No. 1 argand burner. Others are more favourably placed, in that they use the "Metropolitan" argand No. 2. As far as true candle power is concerned, the flat-flame burner used by the consumer is the fairest criterion. But union jet, slit, table top, and other flat-flame burners exhibit the most variable efficiencies—that chosen by the Gas Referees being one of the best. Gas engineers who have had experience with the different types of burners, and with different grades of gas, must have observed that, when the quality of the gas (in terms of calorific value) is degraded, the candle power is reduced at a much more rapid rate in the flat flame than in the argand flame. The No. 2 argand seems to fall off more rapidly than the No. 1, when the latter is tested with a full chimney or 3½-inch flame (the only rational method), instead of at the 5 cubic feet rate.

The following tables and diagram contain comparative figures obtained in testing different kinds of gas with the two argand burners and two of the best patterns of flat-flame burners.

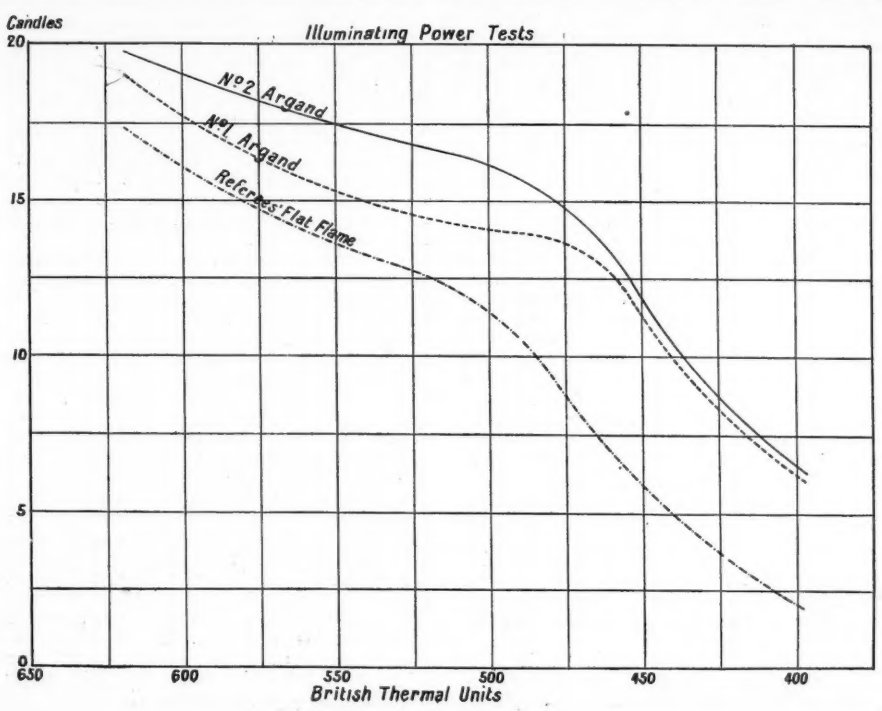


TABLE II.

	Consumption. Cubic Feet per Hour Actual.	I.P. Candles Actual. (Uncorrected).	I.P. Candles at 5 Cubic Feet per Hour (Corrected).	Efficiency. Candles per Cubic Foot (Corrected).
Low-Grade Cannel Gas. (C.V. net = 619.)				
No. 2 argand	5·00	19·10	19·75	3·95
No. 1 argand	4·62	17·00	19·00	3·80
Referees' flat-flame	5·00	16·70	17·30	3·46
Selected ,, ,,	5·00	17·00	17·55	3·51
Standard Coal Gas. (C.V. net = 518.)				
No. 2 argand	5·00	16·00	16·60	3·32
No. 1 argand	6·12	17·00	14·40	2·88
Referees' flat-flame	5·00	12·00	12·45	2·49
Selected ,, ,,	5·00	12·00	12·45	2·49
Low-Grade Coal Gas. (C.V. net = 476.)				
No. 2 argand	5·00	14·55	14·85	2·97
No. 1 argand	6·67	18·00	13·75	2·75
Referees' flat-flame	5·00	8·70	8·85	1·77
Selected ,, ,,	5·00	8·33	8·45	1·69
Poor Coal Gas. (C.V. net = 455.)				
No 2 argand	4·96	12·15	12·65	2·53
No. 1 argand	7·27	17·00	12·10	2·42
Referees' flat-flame	5·00	6·35	6·55	1·31
Selected ,, ,,	5·00	6·30	6·50	1·30
Very Poor Coal Gas. (C.V. net = 397.)				
No. 2 argand	5·00	6·10	6·30	1·26
No. 1 argand	8·82	10·00	6·00	1·20
Referees' flat-flame	5·00	1·85	1·90	0·38
Selected ,, ,,	5·00	1·95	2·00	0·40
Table Showing Fall in Candle Power. (Standard gas = 100.)				
Calorific value	518	476	455	397
No. 2 argand	100	89	76	38
No. 1 ,,	100	95	84	42
Referees' flat-flame	100	71	53	15
Selected ,, ,,	100	68	52	16

It is evident from the foregoing representative figures that, if the flat-flame user is to be considered at all, a sudden halt must be called in descending the scale when we get below 15 candles with the No. 2 burner, and a standard of not less than 15 candles should be set up. It is chiefly in the production of high candle power (over 17 candles with the No. 2 argand) that vertical retorts fail; and thus a low standard of 15 candles with the No. 2 argand will more or less conceal their deficiency in this respect. As previously stated, horizontal retorts must be worked under vacuum in order to reduce the illuminating power to this low figure; and as the candle power diminishes more rapidly than the make of gas increases, the two systems will be more nearly equal on a low candle standard. This applies more especially to testing with the No. 2 argand, as the superiority of this burner over the No. 1 is much less pronounced between 12 and 14 candles than it is between 16 and 18 candles.

If the coal gas falls below standard, it is generally enriched either with benzol or with carburetted water gas, both of which cost considerably more per candle per 1000 cubic feet than coal gas; so that a certain additional cost must be taken into account. On the other hand, a credit allowance for the saving of wages, capital charges, &c., must be made if the yield of gas per ton is extended, as by over-pulling (horizontals) or steaming (verticals). I have here been assuming best normal working conditions. A certain increase in illuminating power and calorific value results, at the expense of the make of gas, through lowering the temperatures of vertical retorts. So far as my experience goes, the loss in gas yield is out of all proportion to the gain in candle power; so that no real advantage accrues by doing so.

Where intermittent vertical retorts are concerned, more is to be gained in sperm value by shortening the distillation period. Sometimes it happens that ten-hour work gives considerably better candle power multiple than either eleven-hour or twelve-hour distillation; the gases given off during the eleventh and twelfth hours being very destructive of illumination. Excessively high vertical retort temperatures have been observed to result in diminished sperm value. In contrast with this, the horizontal retorts of the Birmingham coal-test plant, even at 2100° Fahr. (the highest temperature maintained for tests), have always produced, with normal charging, better illuminating power multiples the higher the temperature employed. In one special test, each of the retorts was charged with coal along only two-thirds of its length, the remaining one-third being left empty, the gas being compelled to go up one ascension pipe—that at the empty end of the retort. In this case there was a marked depreciation in "multiple;" but, strangely enough, no increase in the make was recorded, although the percentage of hydrogen was much increased, as seen below.

Festoons of flowery carbon formed in large quantities on the

TABLE III.

—	Make.	I. P. No. 1.	I. P. Multiple.	C. V. Net.	C. V. Multiple.	Liquor.	Tar.
Normal working	11,790	15·55	183·3	523	6170	37·6	10·8
Retorts two-thirds full	11,330	14·65	166·0	508	5750	27·7	9·4

Gas Analysis.

—	CO_2.	C_nH_m.	O.	CO.	CH.	CH_4.	N.
Normal working	2·17	3·61	0·78	10·01	46·4	31·2	5·8
Retorts two-thirds full	2·07	2·72	0·66	10·81	51·2	28·0	4·5

arches of the retorts at the empty ends; and the ascension pipes showed a tendency to get blocked—this probably accounting for a reduction in gas yield. The composition of this special gas, it will be noticed, happens to closely resemble that made in vertical retorts. The mechanism of the reactions going on in destructive distillation is, of course, very dissimilar, as evidenced by the reduced yields of both liquor and tar.

Probably most gas engineers are agreed that calorific value plays a much more important part than illuminating power as measured by the flat-flame or argand burner; and while some regard must be had for the flat-flame value, the principal standard of test ought to be British thermal units (net) per cubic foot, with candle power subsidiary. It is another question what the statutory heating value should be. In a town like Birmingham, where there are so many industrial uses for town gas, a large reduction in standard is to be deprecated; and probably 500 B.Th.U. per cubic foot, net value, should be regarded as a minimum. Now we know that horizontal retorts in normal working produce comfortably, even from the more common coals, a gas of this value, if excessive over-pulling is not indulged in. Are vertical-retort systems in a similar position? The loss in unsaturated hydrocarbons and methane in vertical-retort gas is set-off to some extent by a lower nitrogen content, a gain in hydrogen, and in the total percentage of combustible gas. On the whole, I believe, the margin of safety will be less; and great care must be exercised to preserve a level gauge if the retorts happen to be leaky.

Taking everything into account, and having special regard to the removal of bars to the progress of new systems of retorting and to the possibility of reducing costs of manufacture, it seems to me, a fair modern standard of quality may be taken as being 500 B.Th.U. (net) per cubic foot, corrected, minimum per diem (principal standard), and 15 candles with the No. 2 argand burner, calculated to a consumption of 5 cubic feet per hour, corrected, minimum per diem (subsidiary standard).

The relegation of candle power to a position of secondary importance has a very important influence in deciding one's choice of a carbonizing plant. The reasons for this have already been indicated. It may further be pointed out that, in assessing values, little or no credit should be given for high illuminating power of 18 or 20 candles, such as is regularly obtained from horizontal retorts working at level gauge, even at high temperatures. Only heat units should be valued; nothing being allowed for or against sperm value so long as it is above standard. This being so, the result follows that horizontal retort systems will be worked in such a way as to extend the make of gas (with nitrogen and carbon dioxide), and thus reap the advantage of reduced costs of manufacture; but, of course, then forfeiting to a large extent their commanding lead in sperm value. In short, ordinary horizontal retort systems can produce 15-candle gas only by dilution, vertical retort systems can produce the same without dilution—that is, by making genuine gas.

It may be thought that the results obtainable under close supervision on a small works like the Birmingham coal-test plant (horizontals) afford too high a standard of comparison. I may mention, however, that the gas manufactured in a recent installation of horizontal retorts at one of the Birmingham Gas-Works has, during the past twelve months, slightly excelled (by 1 to 2 per cent.), both on illuminating power and calorific value basis, the gas made from the same class of coal on the test works. In this particular case there are two or three grave disadvantages to be noted.

In the first place, both tar and liquor are reduced to the extent of about 20 per cent., as compared with the test plant. The gas contains an increased amount of naphthalene, which gives rise to the usual troubles. The impurities, the sulphuretted hydrogen and the carbon dioxide, are about one-third more; and, worst of all, the sulphur compounds other than sulphuretted hydrogen are increased about 40 per cent. Cyanogen reaches the high figure of 8 to 9 lbs. of prussiate of soda crystals per ton of coal. It is interesting to note that the retorts are of similar section to those of the test works, but one-tenth larger in capacity (for the Fiddes-Aldridge stoking machine). The temperatures of carbonizing are about the same; and moderate charges of 9½ cwt. are distilled in 8 hours. But there is one essential difference, in that there is only one ascension-pipe to each retort.

The undoubted advantages of vertical retorts over horizontals of all kinds in increased yield of tar and liquor, and in reduction of sulphur compounds and naphthalene, are very considerable. Their money value, added to the saving in carbonizing wages, probably leaves a substantial balance after making the necessary reduction for gas. There remain the important items of capital charges and fuel account. As regards the latter, there is practically no difference between well-designed settings of either horizontals or intermittent verticals. Continuous verticals, on the other hand, appear to be superior to the extent of 1 lb. to 2 lbs. of coke per 100 lbs. of coal carbonized, and thus gain 1½d. to 3d. per ton of coal. As compared with ordinary horizontal retorts with double ascension-pipes, verticals appear to gain only about 10 per cent. in liquor and 20 per cent. in tar; while they reduce naphthalene considerably, and sulphur compounds by about one-third.

If some sort of differential balance-sheet for vertical retorts may be presented, it will be approximately as follows, per ton of coal carbonized:—

STANDARD OF COMPARISON: ORDINARY HORIZONTALS WITH BEST STOKING MACHINERY.

Gas at 10d. per 1000.

Basis, 18 Candles.		Basis. 500 B.Th.U. and 15 Candles.	Liquor and Tar at Current Prices.	Sulphur Compounds.	Naphthalene.	Wages.
– 13d.	or	– 6d.	+ 3d.	+ 6d.	+ 1d.	+ ½d.	+ 4d.

STANDARD OF COMPARISON: HORIZONTALS WITH ONE ASCENSION PIPE AND BEST STOKING MACHINERY.

– 15d.	or	– 7d.	+ 7d.	+ 10d.	+ 2d.	+ 1d.	+ 4d.

With respect to capital charges, if a round figure of £100 per ton of coal carbonized per diem be taken for a basis as the cost of a retort-house containing modern horizontal retorts, and 200 working days per annum be reckoned on, with interest *plus* depreciation at 15 per cent. per annum, the figure will be $100 \times 240 \times 0{\cdot}15 \div 200 = 18$d. At this rate an increase of 100 per cent. in capital cost will be 18d., and hard to wipe out; whereas an increase of 50 per cent. will be 9d., and possibly balanced by an additional yield of tar or liquor.

RESIDUAL PRODUCTS.

A few words must be said about residuals.

Coke.—Fuel consumption being as nearly as possible the same for intermittent vertical retort-settings as for horizontals working at similar temperatures, it follows that the yield of unscreened coke for sale must also be practically the same. There is a slight difference in the amount of volatile matter left in the coke. This is, as a rule, least in the case of the coke from Dessau verticals, amounting to less than 1½ per cent. This circumstance accounts partly for the increased yield of combustible gas obtained from the latter, particularly hydrogen.

Proof that even "well burnt off" coke will give off quite a large quantity of gas is afforded by placing the finely-divided dry material in a silica tube, connecting this to a mercury pump, and heating the sample, after extracting the air, to a bright red heat. The following figures were obtained in this way:

Volatile Matter.		Yield of Gas.
1·97 per cent.	..	2900 cubic feet per ton.

Composition of Gas.

CO_2.		O.		CO.		CH_4.		H.		N.
0·60	..	0·00	..	6·5	..	2·05	..	86·8	..	4·05

Specific Gravity.		Calorific Value.
·184	..	272

The coke produced by Dessau vertical retorts is well known to be hard, dense, and large, even from Derbyshire poor caking coals. The percentage of unscreened breeze is only half what it is in the case of horizontals on six-hour work. The dust (through a ⅜-inch screen) is only 1 to 2 per cent. as against 3 to 4 per cent. with horizontals, inclines, or continuous verticals. Other things being equal, the intermittent verticals thus gain an advantage of 1d. to 2d. on the coke per ton of coal carbonized. Unfortunately, however, the coke is not so suitable for household use as the ordinary soft coke made by horizontals or continuous verticals. The most serious drawback is the difficulty of ignition.

Once the fire is started (best with a naphthalene fire-lighter and a liberal supply of firewood), there is little difficulty in maintaining it, even with coke from Yorkshire coals, providing always that the coke is properly sized—that is, "small coke," a little bigger than walnuts (over a 1-inch and through a 1¼-inch screen). For stoves, furnaces, and water-gas generators, the intermittent vertical coke is most suitable.

Tar, &c.—To adequately discuss the important differences in the yield, composition, and value of the tar peculiar to vertical retorts requires more time and space than can at present be afforded. There remain interesting questions about sulphur compounds, naphthalene, ammonia, and cyanogen, which are well worthy of careful study.

The advantages and disadvantages of steaming the charge at the end of the distillation will also receive special attention in a separate communication.

At next Tuesday's meeting of the Illuminating Engineering Society papers on the Lighting of Private Houses by Gas and Electricity respectively will be read by Mr. W. H. Y. Webber and Mr. W. R. Rawlings.

ENGLISH GAS-FIRES AND GERMAN REFLECTOR GAS-STOVES.

The "JOURNAL" for March 5 (p. 671) contained an abstract translation of an article by Mr. E. Körting, the General Manager in Berlin of the Imperial Continental Gas Association, in which he compared a typical English gas-fire with two typical German gas-stoves of the reflector type. He concluded by pointing out that the English fire, in addition to giving a very high duty, had the advantages of very small dimensions, very simple construction, moderate gas consumption, and small cost of manufacture. The "Journal für Gasbeleuchtung" of March 16 contains letters by Herr W. F. Siemens, of the firm of Friedrich Siemens of Dresden, and by the firm of Houben Sohn Carl Company, of Aix-la-Chapelle (two of the best known makers of the reflector gas-stove), in which they comment on Mr. Körting's conclusions. Their letters are followed by a reply by Mr. Körting.

Herr Siemens opens by recalling the conclusions (*vide supra*) at which Mr. Körting arrived, and remarks that the latter's experiments did not pretend to be scientifically conducted. In this respect, Herr Siemens says that the majority of experiments on heating are faulty. Strictly an adiabatic room should be used; and failing this, two rooms of which the conditions are absolutely comparable or identical. In addition to fluctuations of temperature, there should be measured also the humidity, pressure, &c., of the air. The temperature ought to be taken by a series of thermometers which either were registering or could be read from outside, so that no disturbance should be caused by the entry or presence in the room of an observer. Even in the most primitive investigations, influences such as the opening of doors, movements of persons, temperature changes in the adjoining rooms or the outer air, should be scrupulously avoided. The walls and the air of the room must be at the same temperature at the outset. It was well known that walls and windows absorbed a great deal of heat during the period when a room was being raised to the desired temperature.

Referring to the comparative trials made by Mr. Körting, Herr Siemens goes on to state that the reflector stove shown in fig. 3 (p. 671) was obviously too small for a room of the size used. Taking the initial heating tests with the English gas-fire and the reflector stove shown in fig. 2 (p. 671), various discrepancies are first pointed out between the results obtained with the two reflector stoves, by way of proving that in the trial of the larger reflector stove (fig. 2) there was some specially large heat absorption which has vitiated the figures obtained with it; and then it is observed that the results found for the English fire were so startling that it must be presumed that a part of the effluent gases passed into the room and contributed to its rapid heating while naturally vitiating the air in it. This presumption was supported by the consideration that, while the gas consumption per hour of the English fire was to that of the large reflector stove as 5:3 during the initial heating of the room, the flue of the former was only half the size of that of the latter. The lower temperature of the effluent gases from the English fire afforded corroboration of the presumption that a portion of them passed into the air of the room. The effluent gases amount to four to five times the volume of the gas consumed. The flue of the reflector stove was about 3½ inches wide, and about 130 cubic feet of effluent gases passed through it in 36 minutes; whereas the flue of the English fire was only about 1½ inches wide, and through it about 212 cubic feet of gas should have had to pass in the same time. Moreover, with all gas-fires, a varying proportion of fresh air was drawn in and discharged with the effluent gases. But the flues were in inverse ratio to the volumes of gases to be passed through them. This disproportion supported the contention that effluent gases passed directly into the room from the English fire.

In regard to the continuous heating test, Herr Siemens states that the large reflector stove (fig. 2) and the English fire were about equal; but the smallness of the flue and the low temperature of the effluent gases with the English fire strongly suggest to him that in this trial also a portion of the effluent gases from the fire passed into the the room. Unfortunately, the proportion of carbonic acid in the air of the experimental room had not been ascertained, and the proportions of carbonic acid stated to have been found in the effluent gases threw no light on this point, because it was not known how much air had been drawn into the flue.

In regard to the quality of the air of the room, Herr Siemens proceeds to say that experiments on the point with the English type of fire are desirable. These fires have not become common in Germany and Austria-Hungary, although both in England and France they have been widely used for a long time; and apparently little importance is attached to the quality of the air there. The flames of these fires, on striking the incandescent fuel, are very much cooled; consequently, the fuel gases have not the necessary *vis viva* to pass freely into the chimney. Incomplete combustion of the gas may also readily occur. The open form of fire, moreover, does not provide a proper draught; and hence the volume of the heavy carbonic acid entering the room is further increased. The small cross section of the flue also contributes to the escape of the effluent gases into the room. Such fires have been known for a long time, and the illustration (fig. 1) given with Mr. Körting's article does not appear to show any con-

siderable improvement in their construction. There may perhaps be improvement in the quality of the fuel or in the construction of the bunsen burners used. In the past, broken portions of fuel have been apt to obstruct the burner and facilitate striking-back of the flames, thereby increasing the vitiation of the air. Whether there is such an improvement, he (Herr Siemens) is unable to judge at the moment.

Herr Siemens next observes that the English type of fire acts almost exclusively by radiant heat, and he is of opinion that the rational heating of dwelling-rooms cannot be effected by radiation alone. Radiation, as employed in the reflector stoves, usually supplements the heating effect; but it cannot suffice to heat rooms rationally. The initial heating of the room would be a very difficult matter with the English type of fire if a portion of the effluent gases did not pass into the room. Mr. Körting has said that the advantage of the English fire depends on the utilization of the radiant heat. He is not, however, correct in stating that the lower strata of air in the room are warmed directly by radiant heat, as radiant heat does not warm air, but passes through it unhindered, and is first felt on striking an object by which it is absorbed. For these reasons, it is unnecessary to protect, as Mr. Körting did, a bright thermometer from radiant heat, as the bright bulb of mercury will reflect the radiant heat, and so will not give rise to special error. There would be no harm in using a screen to protect the thermometer from radiant heat. Mr. Körting, however, used for the purpose a cardboard screen round about the thermometer; and the cardboard would take up the radiant heat, and so affect the air passing over the thermometer bulb, thereby vitiating the readings. Special care in regard to this point is necessary in such investigations. The heat radiated from the reflector stove is in this respect more correctly applied than that from the English fire; for, whereas with the latter the radiated heat traverses the room and strikes the opposite walls or objects or persons directly intervening, the reflector stove directly heats the floor. The air takes up this heat, and gives it off as it rises in the room.

Herr Siemens concludes by saying that he thinks his remarks will have shown that Mr. Körting's experiments were in many respects not sufficiently exhaustive, and that, even with the simplest comparative experiments, a number of conditions must be fulfilled, without which they are almost valueless. He is of opinion that with correctly made experiments, as also with a properly constructed German reflector stove, considerably more favourable results would be obtained with it than with the English gas-fire. He, however, would welcome exhaustive comparative trials, in the hope that they would further the use of gas for rational heating in the truest sense of the word. He considers there is much to be done in heating in general, and gas heating in particular, in working towards an ideal that fulfils the hygienic and economical requirements of the present day.

The letter by the firm of Houben Sohn Carl opens with the comment that tests had not been made in Mr. Körting's trials to ascertain whether products of combustion passed into the room. This must doubtless have been the case to a large extent with the English fire, the drawing of which shows nothing of much novelty compared with the English gas-fires which have been known for thirty years. Their firm have formerly made frequent experiments with these fires, and have always found the same faults—viz., (1) either vitiation of the air of the room with a moderate chimney draught; or (2) very small heating effect with a strong chimney draught. The incandescent fire-brick wall standing out in the room, and the perforated bodies in front of it draw in so much surplus air that the small canopy above, with the narrow flue, cannot dispose of the large quantity of products of combustion mixed with air unless the draught is quite abnormally strong. In the latter case, the effluent gases pass almost unutilized into the chimney, because there are no surfaces to be heated by them. These gas-fires have formerly been made in Germany also, but have gradually given way to the reflector stove. One point which it has taken a long time to overcome has been the construction of reflector stoves with horizontal heating chambers. For years past, their firm have built only stoves with vertical heating-tubes for the air, which collect no dust, and therefore do not give rise to any smell.

Mr. Korting's Reply.

Mr. Körting, dealing first with Herr Siemens' letter, says that it appears to him that theoretical considerations have little or no value in the case, but that exhaustive comparative trials between the two types of stove, with the use of every scientific auxiliary, are required. Unfortunately, he had not apparatus available for determining the carbonic acid in the air of the experimental room, so that he could not ascertain with precision that there was no escape of products of combustion into the room. But he formed the firm opinion, which was substantiated by repeated tests with cigar smoke, that all the products of combustion went into the flue. It was difficult to understand how it could be otherwise, as the construction of the fire provided a nearly vertical flue almost without obstruction or change of direction. The English fire had afterwards been taken from the experimental room to an ordinary living room, and had given complete satisfaction during very cold days in the winter. There was no doubt that if an appreciable proportion of the flue gases had passed into the room, a disagreeable effect would have been noticed. It might further be observed that no people were more voracious of air and more sensitive to bad air than the English; and hence the English type of fires would certainly not have become so extensively used if the ventilation had not been faultless. If the gases produced by combustion were generally discharged into the room by it, this would be immediately noticeable by the smell. It might perhaps be of interest to remark that in past years reflector stoves, which in his opinion then were superior to the English gas-fire of the time, had been sent to friends in England. They had been returned as useless, with the remark "that they make the rooms stuffy."

In his reply to Houben Sohn Carl Company's letter, Mr. Körting says he thinks that the firm has made a mistake in supposing that the English gas-fire has not improved in the last thirty years. English gas engineers took the view that there had been great improvement. This was confirmed by the great extension of heating of rooms by gas in recent years in England. For instance, in the last half-yearly report of the South Metropolitan Gas Company, it was mentioned that the Company now had 33,000 gas-fires on hire, and that on cold days the gas consumption went up 25 per cent. Consequently, the modern English gas-fires have enjoyed very great popularity, whereas the Imperial Continental Gas Association, notwithstanding vigorous advertisement for years, have not succeeded in letting more than 1500 reflector stoves on hire in Berlin. Mr. Körting remarks further that the English gas-fire enjoys to a large extent the goodwill and the assistance of English medical men, and heating by gas is largely used in hospitals, &c., in England. Bearing in mind the well-known objection of English people to bad air in general, there could scarcely be any question of products of combustion escaping into the room. He had tried the English fire in various rooms, and was quite satisfied with the heating. The improvement in efficiency of the modern English fire must be traced to the combustion being distributed in a thin layer over a large surface, so that a very vigorous exchange of heat took place with the air of the room. It would be more to the point if makers of stoves, instead of discoursing on theory, would carry out practical trials, with a view to answering the question whether the English type of gas-fire was applicable to German conditions, and might not be preferable to the reflector stove.

HANDS PATENT COOL INVERTED GAS-BURNER.

The "A. V. C." Burner.

A new inverted gas-burner which has special features that will commend themselves is the "A.V. C." of Messrs. Hands and Co. The burner has several advantages—one being that it is constructed so as to act as an anti-vibrator; another is the facility provided for the maintenance of efficiency by cool air and gas adjustment; a further one is the means taken to prevent discoloration of fittings; and yet another one is the means afforded for simply disconnecting the burner for cleaning. The burners are also designed so as to isolate the adjuster from the creeping heat given off by the gas. There are two types of the "A.V.C." burners—single swing and double swing. The incorporated points as to the cool adjustment and non-discoloration of fittings are the special features that made the firm's Hands No. 3 burner popular. The advantage as to non-discoloration should be of special interest to all gas engineers, especially where keen electrical competition has to be combated, as an argument often used by electricians in trying to proselytize gas consumers is "that gas discolours your fittings." The firm are convinced of the success of the burner in this respect, so much so that they are prepared to undertake the relacquering of any polished brass fitting that can be proved to have become discoloured, within twelve months from the date of fixing, through the use of a Hands burner, providing, of course, it has been fixed correctly—with the china deflectors so placed as to throw the products of combustion away from the metal work.

A particular feature of the swing burners is that the bottom part can be easily removed for cleaning purposes—by simply lifting a small catch, and turning the burner slightly. It is also impossible for the gas-adjuster to get hot, inasmuch as the bunsen tube is divided. The burner acting as an excellent anti-vibrator, the advantages for factory or workshop lighting will be at once apparent.

The single-swing burner has all the advantages of the double-swing, except that it has only one swivel, and is a cheaper type of burner; but there is no doubt it is excellent value, and effectively meets the demand for a first-class burner at moderate price. The "A.V.C." burners are silent in action; and the firm assure us they will not light-back. There is thus much to recommend them.

The Vertical Gas-Retort Syndicate, Limited, have received advice from the Dessau Company to the effect that the following repeat order has been received for Dessau vertical retorts: At Halle, five beds of twelve 4-metre retorts, and two beds of ten retorts—making eighty retorts in all.

CHRONOLOGY OF EARLY GAS LIGHTING.

In connection with the approaching gas centenary celebration in Philadelphia, to which reference has already been made in our pages, the American "Gas Institute News" has reprinted from the "Pacific Gas and Electric Magazine" a chronology of the early development of gas lighting, compiled by Mr. W. R. Morgan, of San Francisco. With the omission of some of the earlier dates, referring to coal, &c., the events set forth are as follows.

1609 Van Helmont settled in Brussels, and gave the name of "Gas" (from "Geist," meaning ghost or spirit) to the aeriform bodies produced by combustion and by fermentation.
1645 British Royal Society formed (constitution adopted 1662).
1659 Thomas Shirley investigated a natural gas well in Lancashire, England, and wrote the first description of experiments with natural gas published in the "Transactions" of the Royal Society for June, 1667.
1662 The use of coal had become so extensive that in 1662 the sum of £200,000 was raised by means of a "Hearth Tax" imposed on fireplaces by King Charles II.
1662 Robert Boyle enunciated the statement known as "Boyle's Law."
1660 to 1670 Dr. Clayton experimented with natural gas in Lancashire, England, and distilled coal to produce gas, which he stored and lighted. An account of his experiments was published in the "Transactions" of the Royal Society for 1739.
1675 Coal distilled for the production of tar.
1676 Boyle's Law confirmed by Mariotte.
1679 A "cole mine" near Ottawa, Ill., U.S.A., mentioned by Father Hennepin, a Jesuit missionary.
1697 First street lighting ordinance passed in New York City.
1700 Coal exported from England to European countries.
1726 Dr. Stephen Hales published "Vegetable Statistics," describing his experiments on the distillation of coal.
1749 Coal mined in Richmond Basin, Virginia, U.S.A.
1754 Dr. Joseph Black discovered carbonic acid gas (carbon dioxide).
1755 Coal discovered in Ohio, U.S.A.
1760 Theory of specific heat, and of latent heat, propounded by Dr. Steven Black.
1762 Oil street-lamps first lighted in New York City.
1766 A gold medal offered by the French Academy of Science as a prize for the best essay on street lighting, won by Lavoisier.
1767 Hydrogen discovered in water by Henry Cavendish.
1774 Oxygen discovered by Joseph Priestly in England, and by Charles Scheele in Sweden.
1775 The composition of atmospheric air discovered by Lavoisier.
1776 The water-lute (water-seal) invented by Priestly.
1781 A patent granted to the Earl of Dundonald for distilling coal. All the products of distillation were mentioned except gas.
1781 The gasholder invented by Lavoisier.
1784 Jean Pierre Minckelers lighted gas distilled from coal as a demonstration to his class in the University of Louvain.
1790 Anthracite coal first mined in Pennsylvania.
1792 William Murdoch distilled coal in an iron retort, and conducted the gas 70 feet through tinned iron and copper tubes to light his house and grounds at Redruth, in Cornwall.
1797 Murdoch lighted with gas his house and office at Old Cumnock.
1798 Murdoch lighted with gas one of Boulton and Watt's shops at Soho, near Birmingham.
1799 Murdoch invented the "D" slide-valve (used in steam-engines and gas-meters).
1799 (Sept.) Philippe Lebon (in France) patented a "Thermolampe" for the production of gas by distillation from wood, coal, &c.
1801 Lebon lighted with gas his house and gardens in the Rue St. Dominique, Paris.
1802 (Apr.) Murdoch gave a public display of gas lighting at Soho, to celebrate the Peace of Amiens.
1803 Frederick Albert Winsor began experimenting with Lebon's gas apparatus at Hyde Park, London.
1804 Murdoch built gas-works and lighted Boulton and Watt's shops at Soho.
1804 (May) Winsor obtained first English patent for gas-making apparatus.
1804 Winsor gave a public display of gas lighting at the Lyceum Theatre, London.
1805 Murdoch built gas-works and lighted the cotton mill of Messrs. Phillips and Lee, at Manchester; 900 burners were supplied.
1805 Samuel Clegg built gas-works and lighted the cotton-mill of Mr. Henry Lodge, near Halifax.
1806 Edward Heard patented a process of using lime as a purifier.
1806 David Melville, in Newport, R.I., lighted his house with coal gas.
1806 (Dec.) Lead pipes were laid in Pall Mall, London, by Winsor. These were the first gas-mains laid in a public street.
1807 (Jan. 28) One side of Pall Mall lighted with gas.
1807 (June 4) Both sides of Pall Mall lighted with gas.
1807 (July 12) First meeting of gas stockholders (proposed National Light and Heat Company, London).
1808 (Feb. 25) Murdoch read a paper describing the gas installation at Phillips and Lee's cotton-mill, before the Royal Society, and was awarded the Count Rumford Gold Medal.
1809 (May 5) Hearing before the House of Commons, upon Winsor's application for a Charter for the "National Light and Heat Company." He was opposed by Murdoch and Watt.
1809 Clegg wrote a paper on the application of gas lighting to mills and factories, and was awarded a silver medal by the Society of Arts.
1809 Wet-lime purifier introduced by Clegg in a plant to light Mr. Harris's factory at Coventry.
1810 Application made to Parliament by Winsor and his stockholders to form the London and Westminster Gaslight and Coke Company.
1810 Act of Incorporation passed by Parliament in favour of the London and Westminster Gaslight and Coke Company.
1812 (Apr.) A Royal Charter granted to the London and Westminster Gaslight and Coke Company. This was the first gas company formed.
1812 The hydraulic main introduced by Clegg in a plant to light the cotton-mills of Ashton Brothers at Hyde.
1813 Clegg became Engineer of the London and Westminster Gaslight and Coke Company.
1813 (Mar. 18) David Melville obtained a patent on his apparatus for making coal gas.
1813 (Dec. 31) Westminster Bridge lighted with gas for the first time.
1814 (Apr.) The oil street-lamps of St. Margaret's Parish, Westminster, were replaced with gas-lamps.
1815 (Dec. 9) First gas-meter invented by Clegg.
1815 (Dec. 28) Gas lighting first proposed for Philadelphia by Mr. James M'Murtie.
1815 First treatise on gas lighting published by Frederick Accum.
1816 The cylindrical gasholder first appeared, constructed at the works of the London and Westminster Gaslight and Coke Company, under the direction of Samuel Clegg.
1816 First gas company incorporated in the United States, at Baltimore, Md.
1816 Clegg invented the wet meter, with revolving drum.
1817 Clegg's wet meter remodelled and improved by John Malam.
1819 (June 19) Ed. Heard and David Gordon obtained a patent for compressing gas in metal drums to furnish a portable supply.
1820 Process of oil-gas manufacture patented by Taylor and Martineau.
1821 Act of Parliament passed, authorizing the erection of oil-gas works.
1821 (Apr.) Oil-gas works built at Bristol, Colchester, Dublin, Edinburgh, Hull, Leith, Liverpool, Norwich, Plymouth, and Taunton.
1823 Malam patented a process of dry-lime purifying.
1823 The Boston (Mass) Gaslight Company established.
1824 (Jan. 19) Broadmeadow patented the exhauster.
1825 The gas-governor invented by Samuel Crossley.
1825 New York Gaslight Company established.
1825 Benzol discovered by Faraday.
1825 First gas-lamps in Brooklyn, New York.
1828 First gas-works in Boston, Mass., built on Hull Street.
1829 (Jan. 1) First gas-lamps in Boston lighted in Dock Square.
1830 Manhattan Gaslight Company established in New York.
1832 Meters first manufactured in the United States by Samuel Hill, in Baltimore, Maryland.
1833 (Mar. 19) A dry meter invented by James Bogardus, an American engraver, was patented by Miles Berry.
1833 (Oct. 12) The telescopic holder patented by Hutchinson, Engineer of the London Metropolitan Gas Company. This holder was invented in 1824, and described in Creighton's Encyclopædia.
1835 Gas-meters manufactured in New York by Young, and in 1836 by Samuel Down.
1840 Meters adopted by the London and Westminster Gaslight and Coke Company.
1843 Wm. Richards made a dry meter with two diaphragms, two slide-valves, and a dial, which, with minor improvements, is the meter in use to-day.
1846 Gas-meters made legal in France.
1849 A company formed in Boston, Mass., by Mr. George Darracott, to manufacture meters.

Dates of Gas Lighting in Principal Cities of the World.

1807 London, England.
1816 Liverpool, England.
Baltimore, Md.
1817 Manchester, England.
1818 Sheffield, England.
Glasgow, Scotland.
Edinburgh, Scotland.
1819 Birmingham, England.
Bristol, England.
Paris, France.
Brussels, Belgium.
1822 Munich, Germany.
Belfast, Ireland.
1823 New York, N.Y.
1825 Amsterdam, Netherlands.
Hanover, Germany.
Ghent, Belgium.
1825 Rotterdam, Netherlands.
1827 Berlin, Germany.
1828 Boston, Mass.
1829 Dresden, Germany.
1832 Louisville, Ky.
1833 Vienna, Austria.
New Orleans, La.
1834 Havre, France.
1835 Caen, France.
Amiens, France.
Bologna, Italy.
St. Petersburg, Russia.
Lyons, France.
1836 Philadelphia, Pa.
Pittsburg, Pennsylvania.
1838 Nantes, France.
Leipzig, Germany.
1840 Cincinnati, Ohio.
Montreal, Canada.
1841 Manchester, N.H.
Sydney, Australia.
1842 Toronto, Canada.
1843 Halifax, Canada.
1844 Hamburg, Germany.
1845 Madrid, Spain.
1846 Rouen, France.
St. Louis, Mo.
1847 Fall River, Mass.

1847	Breslau, Germany.
	Newark, N.J.
1848	New Haven, Conn.
	Paterson, N.J.
	Providence, R.I.
	Rochester, N.Y.
	Washington, D.C.
	Buffalo, N.Y.
1849	Quebec, Canada.
	Norfolk, Va.
	Cleveland, Ohio.
	Detroit, Mich.
	Syracuse, N.Y.
	Utica, N.Y.
1850	Chicago, Ill.
	Columbus, Ohio.
	Hartford, Conn.
	Worcester, Mass.
	Kingston, N.Y.
1851	Hamilton, Ohio.
1852	Indianapolis, Ind.
	Memphis, Tenn.
	Buenos Ayres, Argentina.
1853	Brockville, Canada.
	Rome, Italy.
	Heidelberg, Germany.
1853	Milwaukee, Wisconsin.
1854	Belleville, Ill.
	Nice, France.
	St. Joseph, Mo.
	San Francisco, Cal.
	Toledo, Ohio.
	Ottawa, Ill.
1855	Vera Cruz, Mex.
1856	Atlanta, Ga.
	Melbourne, Australia.
	Warsaw, Russia.
1857	Scranton, Pa.
	St. Paul, Minn.
	Copenhagen, Denmark.
1858	Tasmania Island.
1860	Portland, Ore.
1861	Malta Island.
1862	Shanghai, China.
	Hong Kong, China.
1863	Smyrna, Asiatic Turkey.
1864	Alexandria, Egypt.
1865	Bombay, India.
	Rio de Janeiro, Brazil.
	Christchurch, New Zealand.
1867	Moscow, Russia.
	Kansas City, Mo.
1867	Los Angeles, Cal.
	Oakland, Cal.
1868	Ceylon (Island).
	Omaha, Neb.
1869	Stockton, Cal.
1870	Leeds, England.
1871	Yokohama, Japan.
	Minneapolis, Minn.
1872	Tokyo, Japan.
	Monte Video, Uruguay.
1873	Seattle, Wash.
1878	Cologne, Germany.
1879	St. Johns, Newfoundland.
1885	Takoma, Wash.
1887	Spokane, Wash.

It will be noticed there is some apparent conflict in dates as to the part played by David Melville, of Newport, R.I. As near as can be learned now, Mr. Melville first constructed a plant to light his own home, probably about 1806, and later installed a plant to light a cotton mill at Watertown, Mass., and still later a plant at Providence, R.I., for a similar purpose, having in the meantime applied for a patent, which was granted in 1813.

GAS IN ARGENTINA.

Some Views on the Prospects of a Great Industry.

By E. B. Hutchinson.

It is an old saying that travel abroad opens and enlarges the mind more than anything else. To those interested in the development of the gas industry, this applies at least as much as any other; consequently a few observations on the state of affairs prevailing in a Spanish-speaking country on the other side of the world may, perhaps, be of some interest and value.

First, however, let me refer to Lisbon, one of the ports of call *en route* for South America. The large gas-works are situated at the river side, at a convenient spot for unloading shipments of coal. In the city itself, there is no doubt that gas at present has the ascendency over its rival electricity; and this is very comforting, seeing that Lisbon is one of the best lighted places it has ever been my lot to visit. The streets, it is true, are narrow; but this does not altogether explain how they come to be so well illuminated, which is doubtless caused by the excellence and good arrangement of the lights. Strangely enough, to a Britisher, the inverted mantle does not seem to have made any progress. As yet, almost all lights are of the upright—thin burner and mantle of the French type—class, giving, what seemed to an observer, an excellent light, which fact perhaps accounts for the absence of the inverted type. Then, again, the light is well utilized, and reflectors are fitted over a large percentage of burners, so that at night the shops present a very brilliant appearance. Not one flat-flame burner did I see in two nights' wanderings. Electricity seems to be used in the form of large arcs in the public squares, and also to some extent for general lighting; but I fancy that as soon as the high candle-power compressed-gas lamps, with inverted burners, which I saw by the gas company's office, become known, they are likely to replace many arc lamps.

The condition of gas affairs in Argentina is more or less a reflection of the whole state of the country—*i.e.*, that of unusual growth and rapid development. The Argentine Republic is composed of (say) five or six towns of respectable size, as we know it; but all around is agricultural land, with small towns and villages, mostly in a very primitive state. Indeed, many have only been founded within the last ten or fifteen years, since the railways started their policy of extension on a large scale. Buenos Ayres, the capital of the country, is by far and away the largest city, with a population of 1¼ million people, but covering an area, with suburbs, nearly equal to that of London. It is a huge city, and has increased so rapidly that it has been quite impossible for the gas-mains to keep pace with its growth, and, consequently, now many of the outskirts are provided with no light except electricity, or often only oil.

These conditions of rapid extension which are characteristic of Argentina to-day are, unfortunately for gas interests, rather in favour of the rival illuminant electricity; for it is generally allowable for the electric wires to be strung up all over the place on posts. As for the wiring of the houses, it is almost all done on the surface and in the cheapest way possible; the appearance of the installation seeming to matter very little so long as the light is there. This is typical of the methods in force everywhere. What matter if a town is disfigured by many overhead wires, or if a room is spoilt by the rough-and-ready installation (very often consisting of a single wire hung from the ceiling with one lamp without a shade), provided that the desired end is reached, and that in the cheapest manner. The Argentino argues that he wants light, that the light is there, and that is all that matters. As for the question of cost, in a country so prosperous as Argentina, where money is so plentiful on every hand, and where there is practically no destitution, the difference in cost between gas and electricity, even if it were so great as it is at home, is not a thing that carries any great weight. Gas is, therefore, handicapped by the fact that electric current can be distributed over a given district, and installed in buildings in a decidedly cheaper manner than gas, which at least requires the mains to be underground, and for the piping to be run in a less slipshod manner than the electric wires. That fires are of frequent occurrence owing to the faulty nature of electric installations is a well-known fact; but these are not looked upon in the same light as they would be in England, and are put down more or less as part of the risk always run in a new country.

Another feature inimical to the gas industry is the extremely dusty nature of the country. There being no stone procurable, it is impossible to make-up the roads except at a prohibitive cost, which results in their being left more or less to themselves. This means that generally there are two or three inches of light dust, which the least movement of wind or traffic stirs up; and the dust is of such a fine character that it hangs about much longer than we, of the Old Country, are accustomed to. As a consequence, a thick coating accumulates very rapidly in all rooms, and soon chokes up incandescent burners, unless they are frequently cleaned. In spite, however, of the fact that in railway travelling the dust nuisance is accentuated ten times, it is important to note that, rather than fit electric light, three of the large railways almost completely adhere to incandescent gas for train illumination. That they do succeed in getting satisfactory results, in spite of the continual cloud of dust which accompanies every train in dry weather, is a fact; but how it is done is a marvel to one who has seen the difficulties of doing this even in a country like England. Then, again, the numberless small insects and mosquitoes, which make for the light at night time, is a serious matter, and one which has to be tackled by the provision of caps over chimneys and gauze over the bunsen holes.

For the reasons given above, on account of the exceedingly rapid development of the towns, and owing to the fact that electric mains can be laid more cheaply than gas, and also because no capital can be made of the disparity in cost, the decision as to whether gas or electricity shall be employed, in any new place, not previously using either illuminant, usually results in a victory for the electric interests. So that many small towns are already lighted by electricity. The usual procedure is to place an arc lamp at the corner of each square (all towns being laid out in square blocks) towards the centre of the place; while on the outskirts they are usually content with a 30 or 50 candle-power lamp placed at each corner—*i.e.*, four at each crossing—or hung centrally above the roadway, strung on wires attached to the houses on either side.

The gas industry is well established (as is well known) in the large towns of Buenos Ayres and Rosario. But outside of this, little has been done. In the opinion, however, of one who has given no little thought to the question, there should be a great future before gas in the country—not so much on account of lighting as for heating, cooking, and manufacturing use. Houses in Argentina are usually built without any regard to the really cold weather experienced during the winter months, when during the evenings and nights it frequently freezes. No fireplaces or chimneys are found. Consequently and for people accustomed to a hot climate for seven out of twelve months, the cold is felt intensely; the only mitigation possible being bed—which is very generally adopted by the poorer classes—or oil-stoves, which have a large sale. Even for domestic cooking, there is no such thing as a range or fireplace; it is all done over a brazier burning charcoal. For an oven, though not often required in Spanish cooking, a small box-like apparatus is used, placed above glowing charcoal.

Give people who live in this manner gas-cookers and gas-fires in their rooms, and a want will be met which is really pressing, though, owing to the fact that these conveniences are quite unknown, it may not have been definitely expressed. Anything to save trouble is the motto of the country, and gas-cooking will do this greatly. One may ask whether these conveniences will be taken up; and I can only say that in other departments, and especially that of personal comfort, no expense is spared. Money

is, comparatively speaking, no object; for it abounds in a way unknown in the Old Country. Once a man is convinced that a thing is going to be a convenience and a comfort, it will not be long before he will have it installed, especially if he finds his friends are doing likewise. Apart from this, one may say that the want for an easily used heating apparatus has already been indirectly expressed, for methylated spirit rings, spirit stoves, large and small, and oil-heaters—especially those requiring a small air pressure such as the "Primus"—are in use in every house, and are considered quite indispensable. In fact, a man seldom travels without his "Etna," which he uses to boil water, or for other purposes. But all these stoves cause more or less trouble and are certainly dangerous, and the advent of the clean and speedy gas-cooker would doubtless soon supersede these makeshifts.

Regarding the question of the actual cost of gas, which labours under the serious disadvantage of having to get its coal supplies from abroad—the States, Natal, or the United Kingdom. Although the cost per ton amounts to between 30s. and 40s., it does not follow by any means that this is going to cripple the industry; for almost every necessary of life is double the price of the same article in Great Britain, and labour is paid accordingly. Thus, although to British ideas the cost of gas might appear prohibitive, it is not the case that the same would apply in Argentina, where nothing is more certain than that once gas-cooking were well known—*i.e.*, outside such places as Buenos Ayres and Rosario, where it is already well advertised, and half-rate given—it would soon be wanted in every house in the district.

The incandescent burners at present most generally in use are of the thin, narrow, upright pattern of French make; but inverted burners are being gradually introduced. At present, one does not see many gas-burners of British make. But this should prove a promising field if manufacturers will only take a little trouble to ascertain the local conditions, and will describe their goods in Spanish; for British goods have the best of names, and there is a decided preference for them among the local shopkeepers.

If it is considered that too glowing a picture has been presented of the prospects of the gas industry in Argentina, it must be attributed to the remarkable prosperity which is prevalent everywhere and in every branch of life; and which is so great that everything seems to flourish. British capital, with its railways, banks, and steamers, has already made Argentina what she now is. It seems probable to the writer that no more profitable outlook could be found in the future than the establishment of gas-works in some of the growing inland towns and villages.

SOME NOTES ON THE DELIVERY OF GAS THROUGH SMALL PIPES.

By Henry O'Connor, F.R.S.E., Assoc.M.Inst.C.E.

The necessity of investigation into the above question led to the further examination of the records of the tests made by Mr. D. Chandler, of the South Metropolitan Gas Company, and the preparation of a graph from his figures [reproduced herewith], which also contains curves showing the calculation by Pole's formula for the pipes of each size—namely, ¼-inch, ⅜-inch, and ½-inch—when delivering gas of specific gravity ·425 through 50-feet lengths of each of the pipes.

The first point which strikes one is the change in direction of the curve for the various pipes at certain points; and these occur, in the case of the ¼-inch pipe, at 10-10ths pressure with the pipe 6·25 feet long, at 18-10ths on that of 12·5 feet long, and at about 30-10ths on that 25 feet long, and probably the point for the pipe 50 feet long is outside the range of the tests made by Mr. Chandler. The same thing occurs with the ⅜-inch pipe; but it is not very distinguishable on the shortest length. On this 12·5 feet long, it shows at about 5-10ths, on the 25-feet length at about 11-10ths, and on the 50-feet length at about 20-10ths. Again, on the ½-inch pipe, 12·5 feet long, it appears at about 2½-10ths, on that 25 feet long at about 4-10ths, and on the 50-feet length at 18-10ths. This gives the points, as regards the pressures, at which the deliveries begin to change their rates. A further examination, however, leads to another conclusion; and that is, that this critical point occurs in each pipe at a certain speed or velocity in the pipes quite independently of the pressures at which the gas is passing. It will be noticed that the rate of delivery for the ¼-inch pipe is about 31 to 32 cubic feet per hour in each case; for the ⅜-inch pipe, 46 to 48 cubic feet per hour; and for the ½-inch pipe, about 67 cubic feet per hour. This works out to velocities of 24·8 feet per second for the ¼-inch pipe, 17·3 feet per second for the ⅜-inch pipe, and 13·7 feet per second for the ½-inch pipe. It is therefore evident that there is a critical velocity for each size of pipe; and this might be expected when the matter of skin-friction comes to be considered.

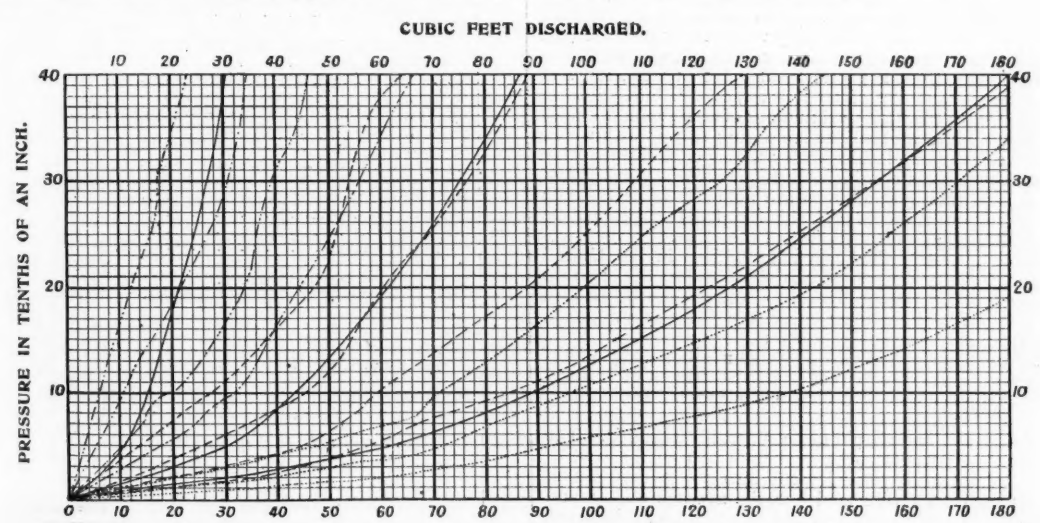
In the case of a large pipe, the friction of the sides would cause eddies in proximity to the interior surface; but the main body of the fluid passing through the pipe will be comparatively free from such eddies. With the smaller pipe, however, the skin-friction would extend right into the body of the pipe, and will affect the whole area of the pipe and the full quantity of gas passing through it; while in the case of the larger pipe, it may only affect a small proportion of the gas which is passing. The proportion of the circumference to the area is large in the case of a small pipe as compared with a larger one—amounting as it does in the 1-inch pipe to 4 to 1; while in a 16-inch pipe the figures are reversed, and become 1 to 4.

The usual suggestion of altering the coefficient in Dr. Pole's formula does not apply in this instance, as a different figure in each case and for each pressure would be required to bring it in any way near a correct quantity. For instance, in regard to the ⅜-inch pipe, 50 feet long, the usual coefficient 1350 would require to be 827 at 1-inch pressure, 1020 at 2 inches pressure, and 678 at 3 inches pressure. The graph, however, gives one an idea how this formula may be used to give fairly accurate results. It will be noticed that the curve for Pole's formula in each case follows very nearly the line for half the length of the pipe; and this is strikingly so in the case of the ¼-inch and ⅜-inch pipes. Hence for these sizes it might be sufficient, when making the calculations by this formula, to double the length of pipe through which the gas was passing; and this would err on the right side, except at such pressures as below 2 inches in the case of a ¼-inch pipe and below 9-10ths on the ⅜-inch pipe.

As regards the ½-inch pipe, the doubling of the length would give too low a delivery; and it would be natural to expect that the larger the pipe the more nearly would its delivery approximate to the rate found by the ordinary rule. From a curve which has been prepared, it would seem that with a 1-inch pipe the rule should apply without correction, that with a ¾-inch pipe the addition should equal about 30 per cent., and with a ½-inch pipe the addition to the length should equal 75 per cent. It must, of course, be remembered that these figures obtained by Mr. Chandler were from smooth composition pipes, and that the delivery through rough wrought-iron pipes might be expected to be considerably reduced.

That the graph and the above observations may be of general interest is the reason for their publication.

During the past quarter, the Road Board, with the approval of the Treasury, have made advances amounting to £88,992 from the road improvement fund to county councils and other highway authorities. In the above-named total is a sum of £74,542 for the improvement of road crusts, including grants towards tar macadam, &c., and surface tarring.



STATUTORY FORM OF GAS-WORKS ACCOUNTS.

By Norton H. Humphrys, Assoc.M.Inst.C.E., F.C.S.

During December, 1911, I offered some considerations referring to existing gas legislation and modern requirements, with a view of indicating some of the special directions in which progress and development of business have outstripped or overflown the provisions of the various enactments by which it is supposed to be controlled. It is now proposed to follow, on similar lines, an examination of the capital and revenue accounts in the form attached to the Gas-Works Clauses Act, 1871 (Schedule B.)

The profit and loss, balance-sheet, &c., do not call for special alteration. In order to follow more intelligently the following remarks, it will be desirable that the reader should, as a preliminary, refer to an official copy of the schedule, and also peruse the classical paper explaining and amplifying it, which was read by Mr. Alfred Lass at the annual meeting of the British Association of Gas Managers in 1877 [see "Journal," Vol. XXX., p. 97]. Mr. Lass shows how a working statement can be drawn up; and the form proposed has been widely adopted—not necessarily for publication, but for the use of the directorate and the managing staff of the gas company, and is frequently exchanged between neighbouring gas managers. So, for present purposes, it may well be regarded as part of the schedule and considered in conjunction with it.

It is unnecessary at this late hour to enlarge on the importance of a uniform system of accounts, or of the adaptability of the forms above noticed for this purpose, because it is proved by the practice of the last forty years. There are always some who do not believe in giving away information of any kind broadcast, in view of the possibility that it may get into the wrong hands, and be used to the disadvantage of the company concerned. But opinions have much altered in this respect since the disappearance of the price of gas professional agitator, and of competition in one district. Possibly the average gas manager in 1860 would not have thought it politic to divulge to his own particular crony in the profession as much information as his successor publishes in one form or another every year. This was not a trait peculiar to the gas profession, but simply the common business custom of the day. Secrecy in business matters was generally regarded as a judicious and advisable thing; and when the publication of gas accounts was first suggested, there were plenty of objectors, who urged that if any shareholder required information he could go to the gas-works and get it, and that wholesale publication was simply playing into the enemies' hands by offering facilities for the investigation of prices and profits. I have a recollection of shareholders' meetings where the accounts were taken as read, and explained by the chairman in a manner that would do credit to the Delphic oracle. And that gentleman probably explained to his friends subsequently that it did not do to give away too much. Some of the secrecy, it may be observed, was due to the fact that accounts were not completely kept—a plain cash statement being considered to answer every purpose; and a secretary, manager, or director could not very well divulge matters of which he was utterly ignorant. No wonder the proposal for the free publication of the accounts was regarded as too radical a change on the existing order of things to promise any advantage. Those who prefer "to bear the ills they have" are always in the majority when the ills are reasonably bearable. But no evil consequences resulted; and it would be difficult to find a concern that has sustained substantial injury by overmuch publication.

The objects served by a set of accounts are so numerous that it may be questioned whether one form can cover all, without being incomplete to one party and over-elaborate to another. A director, partly responsible for the proper conduct of the business, requires more detail than a small shareholder, who only wishes to see that the dividend is secure, and the value of the property fully maintained. A Government official, responsible for seeing that all is in proper legal order, requires more information than the clerk to a local authority who only wants to be assured that the profits are not excessive; and a gas engineer, who wishes to study the accounts from a professional point of view, requires figures and details that are of no interest, even if intelligible, to any outsider. With the increased number of shareholders due to extension of the business, and the increasing favour with which it is regarded by the small local investor, the expense of publishing the accounts becomes a considerable item, especially in view of the expansion of such accounts as are about to be suggested; and for other reasons it seems desirable that two forms should be used—one a summary or compendium of the other.

The 2000 or so established gas undertakings in the United Kingdom would average, perhaps, 200 shareholders each; so we may take it that about half-a-million copies of accounts are issued annually. The bulk of these go to fill the waste-paper basket, and only a small percentage serve any useful purpose. Beyond those professionally interested, a very small number really understand the accounts, and would find a plain statement of income, expenditure, and profit sufficient for their purpose. The existing form of accounts is in several respects deficient in the matter of practical information, and should be considerably extended. The engineer or secretary wants to know such details as the cost of insurance, of maintaining incandescent burners, of carburetted water gas as compared with coal gas, the average outlay, and consumption of gas per slot meter, and several other things not shown. On the other hand, the man in the street is already confused by masses of figures that convey no meaning to his mind. One class wants more detail, the other less. I would not propose to radically change the form of the accounts, or to do anything that would interfere with the continuity of comparison as regards previous years. With this proviso, such alterations must necessarily take the form of additions to, or else an amplification of, existing items.

Referring to the form for capital account on the debit side, I would suggest an alteration that is already carried into effect by some companies, and which consists of the elimination of item 1, and the words "since that date." Instead of showing the previous expenditure in one lump sum, it is stated against each item, and the total given at the bottom.

	—	Expenditure to Dec 31, 1910.	Expended this Year.	Total to Dec. 31, 1911.
		£	£	£
1	Lands acquired, including law charges.	1,000	..	1,000
2	New buildings	4,000	..	4,000
3	,, retorts and furnaces	2,000	500	2,500
4	,, water-gas generators	2,000	..	2,000
5	,, condensers, washers, purifiers, engines, pumps, &c.	3,000	200	3,200
6	,, gasholders	15,000	..	15,000
7	,, mains, including laying, paving, &c.	10,000	..	10,000
8	,, services ,, ,, ,,	5,000	500	5,500
9	,, ordinary meters	10,000	1,000	11,000
10	,, slot ,,	2,000	100	2,100
11	,, legal expenses	500	..	500
12	,, special items (if any)	..	..	..
	Total	54,500	2,300	56,800

The advantage of this arrangement is that it enables one to ascertain at a glance the expenditure up to date without reference to previous accounts. Anyone who has had occasion to look up the expenditure on any one item (say, meters) will appreciate this point. Under the usual system, it is necessary to go through the whole of the accounts since the formation of the concern; and the chances are that a complete set is not available—one or more are sure to be missing. It will be observed that the addition to the items proposed is simply dividing No. 3 in the model into five sections, No. 4 into two, and No. 5 into two. This admits of easy alteration in the original form of account, if desired, for purposes of comparison.

In addition to the form as above proposed, it would not unduly complicate the accounts, and would add greatly to their value, if a column was added for details such as the number of furnaces, generators, holders, meters, services, and miles of main.

The chief features in the revenue account are the introduction of carburetted water-gas plant, slot meters, maintenance, and stoves and fittings, &c., on hire. Some of the items are of such a trivial nature that they might be eliminated. Collectors' commission (now almost obsolete) might go to salaries, and stationery and printing to incidentals. No one is greatly interested in these items. Purifying material should be freed from the confusion created by including such items as oil, water, and sundries, and

Dr. *Revenue Account.*

		£ s. d.	£ s. d.
1	(*a*) Coals, including all expenses		
	(*b*) Other materials, including coke		
	(*c*) Enriching material		
2	Purifying material and labour		
3	Salaries of engineers and officers at works		
4	(*a*) Wages at works		
	(*b*) Gratuities, including contribution to workmen's funds		
5	Repairs and maintenance of works		
6	Distribution salaries		
7	(*a*) Repair and maintenance of mains		
	(*b*) ,, ,, services		
8	(*a*) ,, ,, ordinary meters		
	(*b*) ,, ,, slot ,,		
	(*c*) ,, ,, goods on hire		
	(*d*) Maintenance of incandescent burners		
9	Lighting and repairing public lamps		
10	Rents and insurance		
11	(*a*) Local rates		
	(*b*) Imperial taxes		
12	Directors' and auditors' fees		
13	Salaries of office staff, collectors, &c.		
14	General establishment charges		
15	Legal expenses		
16	(*a*) Allowances		
	(*b*) Bad debts		
17	Depreciation on contingency fund		
18	Other items (if any)		
	Total		
	Balance to profit and loss		

Revenue Account.

CR.

		£ s. d.	£ s. d.
1	Sales of gas—		
	Ordinary meter . . . . . c. ft.		
	Slot ,, ... ,,		
	Contract ,, ... ,,		
2	Rents of meters (*a*)		
	,, stoves (*b*)		
	,, fittings (*c*)		
3	Maintenance charges		
4	Residual products—		
	Coke (*a*)		
	Tar (*b*)		
	Sulphate (*c*)		
	Other items (*d*)		
5	Rents, fees, and sundry		

should include labour. In order to retain as far as possible the old numbers, each item required to be divided may have separate sections—*a*, *b*, &c. A column might be left for entries such as tons of coal or coke, gallons of petrol. The following is a specimen of the debtor side of the revenue account.

With regard to the credit side, any chance sales of materials or stores should be credited to appropriate items, and not appear as an item of income. If coal is sold, for example, the amount received from such sale should be credited to, or deducted from, 1 (*a*) debtor side, and not go to swell the total income on the credit side. It is only by strict adherence to this plan that a fair comparison on all-fours can be made with other undertakings. Materials used for other purposes—*i.e.*, coke consumed in the carburetted water-gas plant should not be deducted from sales of coke, but charged at a fair current price, and debited to 1 (*b*) debtor side. The other alterations have already been explained.

These alterations can be carried through to the working statement. In regard to this, it may be remarked that "costs per ton of coal carbonized" are only of use when coal is employed exclusively, or for application to items dealing with coal exclusively. As applied, for instance, to a works sending out 30 per cent. of carburetted water gas, they are not of any use.

Some alteration would be required in the items shown under "stocks" on the balance-sheet, on the same lines as those in the capital and revenue accounts.

USE OF COKE-OVEN GAS FOR TOWN PURPOSES.

DEVELOPMENT IN GERMANY.

By G. STANLEY COOPER.

IN his recent "Cantor" Lectures, Professor Lewes seems to have suggested that there is not much likelihood of the development of the use of coke-oven gas for town purposes taking place in this country. Of course, if it does come, it must of necessity be in the great colliery centres of the North of England; but, at the same time, there are possibilities in long-distance transmission of the gas—a feature successfully carried out in Germany and America. The writer has recently paid much attention to this phase of carbonization and gas production, and is firmly convinced that a few years more will witness the utilization of coke-oven gas in England to a very large extent.

Coke-oven methods have developed wonderfully during the last ten years. Take for example, in comparison with gas-works, the production of sulphate of ammonia. The figures given below show the amount in tons made in 1908 and 1910 respectively:

	1908.		1910.		Increase.
Gas-works	165,218	..	167,820	..	2,602
Coke-ovens	64,227	..	92,665	..	28,438

The enormous increase in the amount of sulphate made on coke-oven plants is undoubtedly largely due to the efforts which have been made to improve the methods of bye-product recovery and to the introduction of the direct process for the manufacture of sulphate.

The disposal of the surplus gas has occupied the attention of coke-oven managers, proprietors, and builders; and it can safely be said that the majority of modern coke-oven plants can supply gas quite as good in every respect as the average town gas. Moreover, gas can be supplied from coke-ovens cheaper than if made in retorts, and as the tar and ammonia are already removed, only purification from sulphuretted hydrogen remains.

For some considerable time in Germany, coke-oven gas has been used for town purposes with conspicuous success and (needless to say) mutual profit; further its use is continually extending in new districts. At Waldenburg, Altwasser, and Salzbrunn in Silesia, Essen, Dortmund, Mülheim, and many other places, the town gas-works have been dismantled, and the gas is obtained direct from coke-ovens in the neighbourhood. Undoubtedly, in the writer's opinion, much the same thing will occur in England before very long.

Recently the writer has had the opportunity of visiting several collieries where Koppers' system of coke-ovens and bye-product recovery is in operation, and from which gas is supplied for town purposes. The results obtained there are most interesting and instructive, especially as the ammonia is recovered from the gas by the "direct" process. Koppers' system of sulphate manufacture—or ammonia extraction—involves only a minimum amount of distillation of liquor. As no water is used for washing the gas, the only liquor to be dealt with is that obtained in the condensing apparatus. As a rule, this is only about half the quantity which would be produced if the ammonia was extracted from the gas by the usual scrubbing process. If, however, the coal is carbonized dry, as on gas-works, this is further reduced to about a quarter of the usual amount. The total yield of ammonia is found to be increased from 2 to 5 per cent. owing to the continuity of the process, and to the fact that there are fewer channels by which the gas can escape. This alone means a considerable increase in revenue from the additional sulphate obtained.

For the benefit of readers who are not familiar with coke-oven practice, it is necessary to state that there are two systems of ovens in general use—viz., the waste-heat oven and the regenerator oven. In the former, practically all the gas evolved from the coal is required to heat the ovens. In the latter, however, the air necessary for combustion is first heated, and this allows about 50 per cent. of surplus gas available for other purposes. The air is heated in the regenerator to a temperature of about 1100° C., while the heat of the waste gases is absorbed by firebrick chequer work, to be transferred at a later period to fresh supplies of air. The ovens are entirely independent of each other, and admit of easy regulation of air and draught for each oven. In the waste-heat ovens there is no surplus gas, and the waste heat can only be used for boiler-firing for steam-raising purposes. In the regenerator system, on the other hand, the surplus gas is combustible, and can, by judicious division, be used for any purpose for which town gas is employed. The great advantage of recovering the surplus heat of the coal in the form of a combustible gas is that it can be used in gas-engines, and hence greater power can be developed than if it were used for steam-raising. From 50 to 60 H.P. per oven can be obtained continuously in this way from an average coal.

Certainly the use of coke-oven gas for town purposes has not progressed very far in this country. The plant at Bargoed (South Wales), working on Koppers' system, has been described in the Press, and it still continues to give satisfaction. Among installations visited by the writer is one at Mülheim-Ruhr (Germany), where the entire gas supply of the town is derived from coke-ovens worked on Koppers' system. This installation has the production of metallurgical coke as its main object; the use of the gas for town purposes being a comparatively recent innovation.

Mülheim has a population of 120,000; and the gas is supplied from two distinctly separate coke-oven plants. These are owned respectively by the Gewerkshaft Deutscher Kaiser (Thyssen), and the Deutsch-Luxembergische Berkwerks and Hütten A. G.—both being engaged in the iron industry. The plant belonging to the latter Company is here described.

The old gas-making plant belonging to the place has been dismantled, and only purification from sulphuretted hydrogen and the distribution of the gas are in the hands of the city. In 1914, the Coke Oven management takes over also the purification of the gas from its own battery of ovens. Another feature of the plant which must be mentioned is that the ammonia is recovered by Koppers' direct process at the coke ovens as sulphate of ammonia. This system works very satisfactorily, and a good yield of sulphate per ton of coal is obtained; the salt being of good colour and quality. It has been stated at various times that the passage of the gas through sulphuric acid in the direct process has a deleterious effect upon it, owing to the absorption of various valuable hydrocarbons. The officials in charge of the plant here, and also at other works, are emphatic in their denial of this, and state that after careful observation, they are unable to find that the gas is affected in any way. No free acid is carried forward from the saturator by the gas. Naphthalene troubles up to the present are quite unknown.

As at all Continental towns, the illuminating power of the gas is not taken into account at all; the calorific value alone being considered. At Mülheim, the Company guarantee a minimum of 5400 calories per cubic metre of gas—about 600 B.Th.U. per cubic foot. In addition to supplying gas to Mülheim, the installation at Deutscher Kaiser supplies Barmen, 40 miles distant.

The Mülheim installation consists of a setting of fifty Koppers' horizontal regenerator ovens. This allows a surplus of about 50 per cent. of the gas made, available for town purposes; the rest being required to heat the ovens for carbonization. Each oven takes a charge of 8 to 10 tons of coal, and the time of carbonization is 24 hours, the temperature inside the ovens being about 1000° C. It is important to note that the whole of the gas produced is not used for town purposes. Only the richer portion of the gas is taken—viz., that evolved from the second to the twelfth hour of carbonization. During this period, one oven will produce about 2000 cubic metres—70,600 cubic feet—of lighting gas having well over the standard calorific value. The average make of the plant is about 300,000 cubic metres per month, and the average yield of the coal is as follows:—

Large coke	65 to 69 per cent.
Tar	5 to 6 ,,
Ammonia as sulphate	1·3 to 1·5 ,,
Surplus gas	50 ,,

The gas produced is of very good quality, and is satisfactory

in every way both for power and illuminating purposes. The following is an analysis of an average sample of the gas made:—

	Per Cent. by Volume.
Carbon dioxide	1·2
Carbon monoxide	6·8
Hydrogen	49·5
Methane, &c.	38·3
Nitrogen	4·2

With regard to the cost of the gas, this is given as 2½ pf. per cubic metre; the gas being unpurified from sulphuretted hydrogen. This impurity is removed by the town authorities at present by the use of oxide. The sale price of the gas in the town is 10 pf. per cubic metre.

A striking feature of many Continental engineering works is the number of high power gas-engines in use. At Mülheim, in one large room are four engines, each of them being of 2000 H.P. Three of them work on furnace gas, while the fourth is arranged to work on either furnace or coke-oven ga at will. At the time of the writer's visit, all four engines were running, the one on coke-oven gas.

REFRACTORY MATERIALS:

THEIR SELECTION AND USE.

By Alfred B. Searle.

In a French contemporary ("Revue des Matériaux de Construction") there was recently published by M. de Blottefiere an article on refractory materials, some portions of which (given below) are well worth the attention of gas engineers. This writer defines refractory materials as "natural rocks or mixtures of such rock," with the following properties.

1.—They resist the highest temperature obtainable in industrial furnaces; this resistance being the intrinsic or essential property of refractoriness, but not necessarily a criterion of the value of the material. The reason of this is the fact that some highly refractory materials rapidly deteriorate in the presence of certain slags or ashes, while in the presence of these some intrinsically less refractory materials are more durable. Hence "refractoriness," or simple resistance to heat, is merely a special property of some materials, and is no guarantee of their commercial value, as it takes no account of their behaviour in contact with the substances heated with them. This fact is often overlooked in specifications and in the selection of materials, in spite of its great importance.

2.—They resist the chemical action of substances in contact with them; but this resistance is only relative, and depends on their chemical composition and their physical characteristics remaining fairly constant. For this purpose, it is essential that the conditions under which they are used shall also remain as constant as possible. One is never able to obtain perfect resistance in practice, because of the unavoidable variations in composition and in the conditions under which the refractory materials are used.

The word refractory is thus applied to two important and distinct groups of materials: (*a*) Those which are resistant to heat in the presence of air, and (*b*) those resistant to chemical actions which occur in consequence of the material being in contact with other substances. Many materials which belong to group (*a*) would be useless under conditions implied in group (*b*), in spite of their greater refractoriness. For instance, some silica bricks can, if used alone, resist a temperature of 1810° C.; but in contact with an alkaline base, they are destroyed at a temperature below 1000°. In the construction of certain kinds of furnaces, crucibles, &c., the fact that chemical reactions take place in contact with the material necessitates the latter belonging to group (*b*); but in some cases the conditions implied in both (*a*) and (*b*) are essential.

Engineers frequently make the mistake of insisting on materials in group (*a*), in specifying simple refractoriness, instead of using those in the (*b*) group—*i.e.*, resistance to chemical action at high temperatures.

Fusibility.

There is much misconception with regard to the terms fusibility and fusion-point, and their relation to the refractoriness of any material. In many cases high refractoriness means a high-fusion point. But this is not invariably the case; and it is necessary to study the temperature at which the material commences to vitrify as well as that at which it fuses completely. The difference between the point at which vitrification commences and complete fusion occurs, is frequently very great. Indeed, some materials, though they have been sufficiently heated, have never been completely fused to have lost their original shape. This difference in temperature between the point of incipient vitrification, and that at which loss of shape occurs, is termed the "range of vitrification." This range is long according to the nature of the material and the impurities ns. With silicates and alumino-silicates having lime as a base, the range is very short —seldom exceeding 30° C. With compounds of other metallic oxides it is much longer; and their action is correspondingly less harmful.

In the opinion of the present writer, the range of vitrification constitutes a far more important standard than does the fusion-point, because it is of little moment at what temperature a material melts, if articles made of it lose their shape and become useless at a lower temperature. This is equally true whether the deformation occurs as the result of simple exposure to high temperature or is due to the additional influence of pressure or blows. A truly refractory material ought not to show the slightest loss of shape when exposed to the highest temperatures obtainable in the furnace in which it is to be used.

Other Conditions.

It is seldom that a refractory material is merely required to resist high temperatures; other conditions must usually be fulfilled in addition to infusibility:

1.—The material may deteriorate rapidly on account of its spalling or breaking-up into splinters. This may be due to its texture being insufficiently felted, owing to the use of too little grog or burned material. The proportion of grog must be carefully regulated, or the material will spall and split on account of irregular expansion, or will crack if the raw material shrinks much.

2.—The material may soon perish on account of its porosity. The fire-gases penetrate into the interior of all porous refractory materials and set up reactions which have serious results. The hydrocarbons in these gases decompose, depositing carbon and causing expansion or even rupture of the pores, and may cause the refractory material to break. This may easily be seen if a block of refractory material is broken, and one portion is set in a furnace so that only the outside of it is exposed, while the other is so placed as to permit the exposure of the fractured face. The former, protected by its "skin" or finished surface, will last far longer than the latter, because the fractured surface is porous and allows the gases to penetrate into the interior of the block. The joints in furnace masonry are, for this reason, a source of weakness and need to be kept in a good state of repair.

3.—The material may be spoiled because it is mechanically weak, not having been fired sufficiently, or at a temperature lower than that to which it will be subjected in actual use. Thus, a clay brick which has been underfired will shrink in use and a silica brick will expand. In the first case, the shrinkage will cause open joints, irregular pressure, general weakness, and leakage; in the latter, the expansion will reduce the stability of the structure, producing spalling and general shortness of service.

Chemical Composition.

The chemical composition of refractory materials should correspond to the reactions which occur when the material is used. For instance, basic substances should not be heated in refractory articles of an acid or siliceous nature, and *vice versâ*. The great diversity of purposes for which refractory materials are used has necessitated their classification according to their behaviour with various reagents—*e.g.*: (*a*) Carbonaceous or silico-carbonaceous refractory materials, such as carborundum. (*b*) Siliceous or acid refractory materials, as Dinas rock, ganister. (*c*) Neutral refractory materials, as chromite. (*d*) Basic refractory materials, as dolomite, magnesia. (*e*) Aluminous or alumino-siliceous materials, as some clays.

Manufacture.

In the manufacture of refractory articles, certain precautions must be observed with regard to the materials used. It is not possible to go into all the details of these; but the following are specially important:—

The materials having been selected according to their composition, refractoriness, &c., it is necessary to ascertain the proportion of plastic materials which can most effectively be used to bind the particles of non-plastic substance. This will vary with the materials and also with the method of manufacture.

The present writer recommends that:

1.—In a mixture of plastic and non-plastic material, the volume of the larger particles should be double that of the plastic material *plus* the fine non-plastic particles. [Many British refractory clays cannot stand the addition of much coarse material.—A. B. S.]

2.—In this mixture, there will be as much less clay, as there is difference in size between the large and the small grains of non-plastic material. In other words, there will be a minimum of clay when the very large particles form the body of the ware and the fine grains are entirely used as diluent. In such a case, the larger particles do not affect shrinkage of the material, but remain embedded in a mixture of clay and non-plastic powder, the shrinkage of which is determined by the proportion of the latter.

It is essential that for every kind of article made of refractory material the proportions of the different sizes of materials which will give the best results should be studied. A good refractory paste may, in fact, be regarded as a kind of concrete in which the pebbles are represented by the coarse grains and the cement-mortar by the fine grains and the clay. The material must be of this nature to obtain the best results; and, consequently, it is necessary to use carefully selected materials, so that all the grains in each portion are approximately the same size. Indeed, the study of a refractory material, when once its chemical composition has been ascertained, is really a study of the granulation of the various particles—particularly those of the coarse grog (*i.e.*, burned clay) and the fine clay and non-plastic dust.

The grog itself should be carefully studied both as regards its nature and the purpose for which it is employed. It should be made of suitable material, carefully mixed, and carefully freed from the coarser of the impurities such as molten material, glaze,

clinker, &c., which will reduce its refractoriness. These precautions are not observed in some works, and the final product is not, therefore, of as high a quality as it might be. Although it is not essential that the grog should be specially burned, better results are usually obtained than when broken fire-bricks, &c., are used instead. In any case the grog must be completely burned; otherwise it will shrink in use and may cause serious trouble.

As it is desirable to obtain as much coarse powder and as little dust as possible in the chamotte, special care is needed in grinding. A very convenient plant consists of a stone breaker of the Blake-Marsden type, followed by a pair of crushing rolls. The latter are of equal diameter, and are both driven at the same speed; the distance between being adjusted to form the largest size of particle permissible in the grog. The material which has passed through the rolls falls on to a series of three or four sieves of perforated steel, which divide the product into grains of various sizes. Any material which is too coarse to pass through the coarsest sieve is returned to the crushing rolls by means of an elevator. The sizes of the perforations in the sieves depend on the articles to be made, and no general figures can be given.

The grog and clay are mixed together in suitable proportions, and are then passed through a pug-mill or open-mixer. The paste so produced is improved by storage before use. Even if no clay is used—as in silica bricks—the graduation of the non-plastic material should be carried out with equal care. The product from the mills is passed over a series of sieves for this purpose, as when lime is the binder its greater activity renders it all the more necessary that the material constituting the bulk of the articles should be of the best possible nature, both chemically and as regards its physical state.

SHAVINGS FOR SCRUBBING WATER GAS.

One of the papers read at the last meeting of the New England Association of Gas Engineers was on the use of shavings in gas-scrubbers; the author being Dr. J. F. Wing, of Everett (Mass.). It was as follows.

The installation of shavings scrubbers for the purification of water gas is the logical advance over giving up a large part of the capacity of the purifiers to a layer of material for absorbing tar and moisture in order to protect the oxide. In such a system, the shavings could not be replenished until the box was emptied; and the changing of a box was caused more by the drenching of the oxide than by its saturation with sulphur.

Our scrubbers follow the tar-extractors, which remove almost all the tarry mist from the gas, which has a temperature of about 90° Fahr. But even then the mist is strong, and, measured by the million feet, carries a great deal of vapour. The scrubbers are 12 feet in diameter, with three stages of dumping trays; and they can be filled conveniently with 2 feet in each layer—requiring 500 bushels of shavings. We empty the whole scrubber at each change, because by the time the top layer is considerably wetted the back-pressure is high. The shavings are planer chips, and they should be coarse, or with a large make the layers must be thinner or changed oftener.

We change a scrubber after a make of about 40 million cubic feet through it. When it is opened, about a barrel of oily water drains from the saturated shavings. The changes are usually two to one of a purifier; and to accomplish the same scrubbing, twice as much shavings would have to be put into a purifier. Then all the nastiness would be at the bottom of a deep box; and until this is opened, the condition of the scrubbing material is conjectural. In the separate scrubber, we have the tests of the pressure and of the gas which has passed to determine the necessity for changing. When the daily make is 4 to 5 million cubic feet to a scrubber, the back-pressure may be from 2 to 8 inches, according to the condition of the material. On dumping the trays, the soaked shavings may cling to them; and we find it helpful frequently to wash them with a hose.

In order to obtain some data about the condition of the gas and the efficiency of the scrubber, the excess vapour in the gas has been determined at the scrubber inlet, after it had travelled 165 feet from the tar-extractors, and at another time, but with all the conditions apparently the same, at the outlet of the apparatus. The excess vapour at the scrubber inlet was 1·13 lbs. per 1000 cubic feet; at the outlet, 0·3 lb. There was removed by passing the scrubbers 0·83 lb., of which 0·7 lb. was water and 0·13 lb. was tar. These amounts, re-calculated for a make of 36 millions, or the amount for changing a scrubber, give for the excess moisture entering the purifiers 10,800 lbs.; and extracted by the scrubbers 25,200 lbs. of water and 4680 lbs. of tar—a total of 29,880 lbs. The excess going to the purifiers (10,800 lbs.), which contained no measurable amount of tar, would not have much effect on a box filled with 250 tons of oxide. A test on a large scale has confirmed these figures for the extraction of vapour. In one case, 500 bushels of shavings gained 7811 lbs.; and another lot 8068 lbs., or 16 lbs. per bushel.

The drip collected from this apparatus during a make of 36 million cubic feet was 17,400 lbs., 6 per cent. tar, which, added to 8068 lbs. in the shavings, makes 25,468 lbs. Therefore the scrubbers prevented 707 lbs. per million from entering the purifiers, and proved their usefulness.

SULPHATE OF AMMONIA PRODUCTION.

By Dr. G. P. Lishman, F.I.C.

At a recent meeting of the Newcastle Section of the Society of Chemical Industry, a paper on "The Production of Ammonium Sulphate in the Saturator" was read by Dr. G. P. Lishman, F.I.C. The text of the paper appears in the current number of the Society's "Journal," from which it is reproduced.

Although the neutralization of sulphuric acid by ammonia is an apparently simple process, the resultant salt will differ in appearance and consistency from one works to the next, and even in the same works from day to day. The differences are brought about by the various conditions of working, such as varied strength of acid in the saturator, varied temperature of the bath, varied percentage of ammonia in the ingoing gases, varied temperature and dryness of the ingoing gases, and varied amount of water, acid, and mother liquor in the bath as made up. Other conditions, such as varied back-pressure on the saturator, also have their effect. Continuously worked saturators may be less liable to variation, especially where the liquor strength is fairly constant; but, even then, there are differences, as it is impossible to keep all the conditions constant.

For the purpose of getting a clearer idea of what happens in the saturator, some series of analyses and observations have been made during the progress of a "bath," as the manufacture of a batch of salt is termed There is obviously much difficulty about sampling saturated liquor containing salt crystals in suspension; and results were often obtained where the percentage of ammonia was clearly much too high. These high results, however, soon came to be easily recognizable and discounted, as it is chiefly at one stage of the bath where they interfere. The saturator in which the tests were made was one of Walker's semi-closed type, without an outlet-valve at the bottom for the salt.

In taking the samples, the Twaddel pot was let down twice, and about 100 c.c. of the second lot quickly poured into a weighed beaker. The net weight of liquor being obtained, it was diluted to the extent that 10 c.c. contained one gramme of the original liquor; and 10 c.c. of this diluted liquor were used for each determination of acid or ammonia. The temperature of the inlet gases was read off from a thermometer fixed in the ammonia-pipe, just over the saturator. These were accurate enough, but the bath temperatures are approximate only. The latter were obtained by placing the thermometer in the full Twaddel pot, and allowing the whole to remain immersed in the bath for five minutes. The pot was then withdrawn, and the reading taken as quickly as possible without removing the thermometer from the liquor.

Before giving the results from the saturator, it will be as well to notice the solubility of ammonium sulphate in boiling sulphuric acid, as ascertained in the laboratory. The results are given in Table I.

Table I.

Twaddel. Hot.	Boiling Point.	Ammonium Sulphate.	Sulphuric Acid.	Water.
	Deg. C.	Per Cent.	Per Cent.	Per Cent.
52	106	51·2	None added	48·8
63	110	52·0	8·8	39·2
..	114	53·1	12·0	34·9
..	115	53·1	14·7	32·2
..	115	54·3	16·1	29·6
..	..	56·7	22·0	21·3
..	140	60 5	30·4	9·1

Boiling neutral ammonium sulphate solution has a density of 52° Twaddel. I am not at all clear why a bath should be usually neutral at 54°. There is, as a rule, not much trouble in taking the density in the neighbourhood of 54°. At the same time, probably most of those having sulphate plants to deal with have noticed bath acid down to 51° or 52°. It will be noticed, too, from the table that the sulphate is more soluble in the stronger acid. The fourth sample, containing 14·7 per cent. acid, would have a density of about 68° or 69° Twaddel; and the 53 per cent. of sulphate it contains represents about the strongest solution that would be obtained in a saturator.

The way in which a bath will behave after being made up appears to be curious. It is made up (say) to a density of 66° Twaddel by mixing acid of 140° Twaddel with mother liquor of 50°, and probably a certain amount of water. As ammonia and steam are passed in, the density for some hours rises, and may go up to 70°. After remaining for some time at this figure, it will commence to go down. At the same time salt begins to separate, and floats about in the boiling liquor, giving it a whiter colour—being what the men call "on the turn." It is just as well that, provided a good boil is maintained, the salt will not settle at this stage, as if it did it would be too acid to dry well. Quite conveniently it remains suspended in the acid liquor till the density falls to 60° or 62° Twaddel, which means that there will now be only some 6 or 8 per cent. of acid present. After this the salt settles, and its extraction can be proceeded with till the acid, which is being reduced all the time, is nearly all gone. It is a common practice to run in a little acid all the time fishing is proceeding. This, however, was purposely avoided during most of the tests of which tables are given here.

The following table of figures shows the variation in the composition of a bath during the whole process :—

TABLE II.

[Bath made up to 66° at 9 a.m.]

Time.	Degrees Twaddel.	Inlet Temperature.	Bath Temperature.
		Deg. C.	Deg. C.
10.45 a.m.	68·0	98·5	110·0
12. 0 ,,	70·0	100·0	110·0
2. 0 p.m.	70·5	100·2	110·5
3.30 ,,	71·5	100·2	113·0
4.45 ,,	70·5	100·2	112·0
6.15 ,,	67·0*	100·0	110·0
7.30 ,,	60·0	99·6	108·0
8.40 ,,	56·0	99·0	107·0
9.25 ,,	54·0	99·0	105·0

Time.	Degrees Twaddel.	Ammonium Sulphate.	Sulphuric Acid.	Water.
		Per Cent.	Per Cent.	Per Cent.
10.45 a.m.	68·0	41·2	23·0	35·8
12. 0 ,,	70·0	43·5	19·5	37·0
2. 0 p.m.	70·5	51·3	15·5	33·2
3.30 ,,	71·5	52·1	13·8	34·1
4.45 ,,	70·5	54·5	11·7	33·8
6.15 ,,	67·0*	48·2	9·7	42·1
7.30 ,,	60·0	49·0	5·3	45·7
8.40 ,,	56·0	48·6	2·1	49·3
9.25 ,,	54·0	49·3	2·0	48·5

* Twaddel difficult to take.

Notes.—Began to fish at 6.15 p.m. Put in acid after taking sample at 8.40 p.m. Liquor feed increased at 4 p.m. Mother liquor from this bath sampled when making up the next was 55° Twaddel, and contained 8 per cent. of acid and 50·4 per cent. of sulphate.

It is noticeable in the first place that the temperature, density, and percentage of sulphate are all highest about the middle stages of the bath, that the acid is gradually reduced, and that the sulphate first rises to a maximum in the neighbourhood of 54 per cent. and then falls to 49 per cent. The percentage of water, taken by difference, varies a good deal more than it should do, probably owing to the ammonia determinations being affected by solid salt in the sampling. The interference in this case is quite inadequate to obscure the main lines of variation in the bath composition. After remaining for a time about the middle thirties, the water suddenly begins to increase up to a maximum near 49 per cent. Several baths have been followed through in this way; and while almost every one of them shows some irregularity, by taking a broad view of them I am led to produce the following diagram as representing, in the case of a normal bath, its varying composition :—

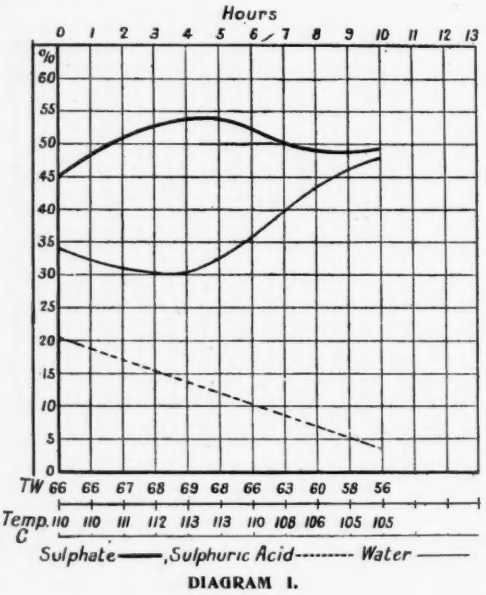
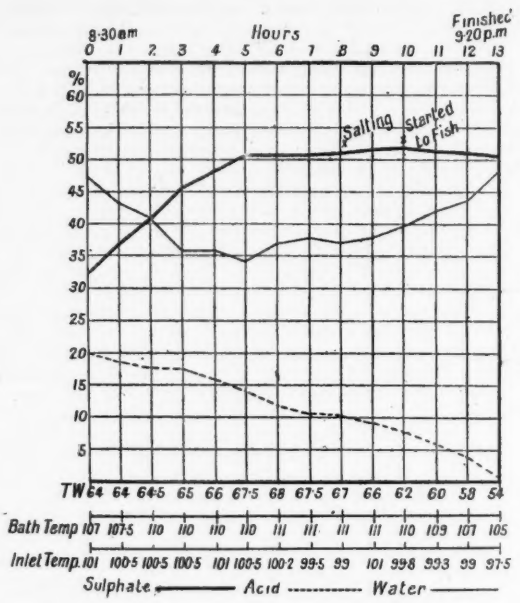


DIAGRAM I.

The density rises in the early stages because the increase in density, due to increase of ammonium sulphate, more than counterbalances the decrease due to loss of sulphuric acid; and this is accentuated by the fact that the sulphate is more soluble in strong than in weak sulphuric acid. Once the bath becomes saturated, the salt crystallizes out all the more rapidly, because as the acid becomes weaker the temperature gradually falls. The rapid rise of the water curve in the later stages of the bath is interesting, and follows as a necessary consequence of the fall of the other two curves concerned.

The next diagram is one of another bath followed through. It was made up to 64° at 7 a.m.; and the strength of liquor was 0·8 per cent.



Made up to 64 at 7 a.m. Strength of Liquor 0·8 per cent.

DIAGRAM II.

In this case the saturator was filled rather higher than usual, and a good deal of water was used in making it up. This becomes rapidly reduced in the early steps; but the bath was rather a watery one all through. There was never any difficulty in sampling or in taking the density. The percentage of sulphate never rose above 52—the saturation-point of 9 per cent. acid as ascertained in the laboratory. The gas liquor was being used straight from the works, just as made; and it must have been very weak between the sixth and ninth hours, as the composition of the bath alters very little during that time.

Another bath followed out was finished much more quickly, having been made up with good mother liquor. It soon became very salty, and continued so almost to the end, consequently the curves for sulphate and water (which is taken by difference) were rather irregular.

In the early stages of a bath, while the density is rising, the hydrometer can give no indication of the composition, as the gravity may be due to either acid or salt. But when the density begins to fall, the solution is saturated for the particular strength of acid, and the hyrdometer gives some notion of the composition. The following is a list of compositions at 66° falling Twaddel, and gives an idea of the limits of accuracy of the instrument for this purpose. Obviously, where the sulphate is more than 53 per cent., the excess is due to solid salt in the sample.

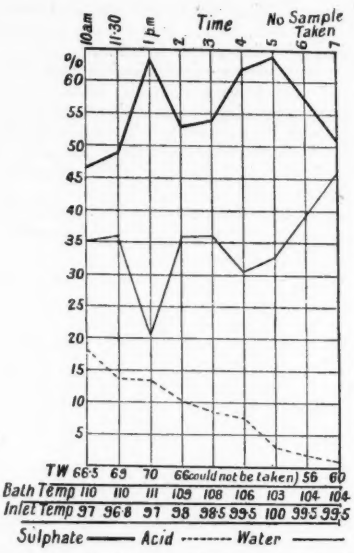
Ammonium Sulphate. Per Cent.	Sulphuric Acid. Per Cent.
55·4	9·0
52·8	10·9
52·0	9·8
58·2	11·6
54·4	12·0

This means that at 66° falling Twaddel there is between 9 and 12 per cent. of acid in the bath. Similarly, it is found that at 60° Twaddel (falling) there is between 4·9 and 6·7 per cent. of acid. Seeing, too, that the bath temperature falls while the density is falling, it would be possible to judge approximately both the density and the composition from the temperature. Where a thermometer can be fixed in the saturator with the scale showing outside, it would advantageously replace the hydrometer.

Another diagram (No. III.) is given which needs little explanation. The bath was made up to 65° at 7.30 a.m., and some acid run in after 5.10 p.m. It was altogether too salty for testing purposes, and is the only one of all those followed through which was a complete failure. It is given as an example of what may sometimes be obtained. But it is not without interest as indicating (at certain points) the composition of the saturator fluid, solid and liquid, as a whole. This has a different but an important bearing in the making of good salt.

It seems to be important for the making of good salt that the percentage of water in the mother liquor at the commencement of fishing should not be less than 40. This makes for a free boil, and means that the acid in the mother liquor does not exceed 5 or 6 per cent. If a bath be made up too low in density (say) with 10 per cent. acid, it will never make salt, but only mother liquor, as the acid will all be gone before saturation takes place. If it be made up too high, the salt will separate out in quantity, while the acid is still, perhaps, 12 or 14 per cent. In this case the liquor is too heavy for the salt to settle, and the whole thing becomes nearly solid. The result is local neutralization and blue salt.

In what has been said, little account has been taken of the solid salt present. The percentage of water on the whole saturator contents, or rather on the whole floating contents, has a bearing



Both made up to 65 at 7.30 a.m. Some acid run in after 5.10 a.m.

DIAGRAM III.

upon the resultant product which must not be overlooked. The solid salt must have room to sink. As is seen from the last diagram, this percentage may be as low as 20 without any harm resulting; but this is about the minimum.

MORE AMERICAN VIEWS ON CALORIMETRY.

In the "JOURNAL" for the 5th of December last (p. 685), we gave an abstract of a paper prepared for the American Gas Institute by Mr. Charles O. Bond, the Chief Photometrist at the Philadelphia Gas-Works, on the photometry and calorimetry of gas. At the recent meeting of the Indiana Gas Association, an address on the latter subject was delivered by Professor PARR; and the following are some extracts from it.

To my mind, the interests that centre in the gas business are paramount in the industrial world to-day. Twenty-five years ago, Mr. Siemens said (you no doubt are familiar with the quotation): "It is positively barbarous to burn coal in the raw state." Still we have been going on burning it in that state, and making smoke and fouling the air with smoke and getting poor and lean efficiency out of it. Twenty-five years from now, the state of the case will be very largely changed. While there has been good progress in the last twenty-five years, I anticipate that more will be made in the next.

I think I am justified in this proposition, for the reason that the year 1911 must serve, it seems to me, a sort of changing-point in the proposition, because in that year there were delivered—and I think this is a fair index for my statement—three addresses of a chemical sort which would be notable in any year, but especially notable in their relation to the gas business. One of them will, to my mind, stand as the greatest chemical address of the year, if not for many years, no matter whether you relate it to the gas business alone or to any chemical subject. The three addresses were all of this sort. The last one—perhaps the one that will appeal to you least—was by Professor Lewes, the great English investigator of gas and coke manufacture. It details his study of the conditions and elements in coal which are responsible for gas as we want it, and for coke as we would like to have it. It comes nearer assembling his own knowledge and that of other experimenters to give us an idea as to what the manufacture of coke really is than anything else that has been published.

The next address to which I referred was delivered in the summer by Sir William Ramsay. His work has been on the raw elements, and, as President of the British Association for the Advancement of Science, he dealt primarily with the idea that the coal resources of Great Britain were limited, and that if the supremacy of the British nation, was to continue, the coal supply must be conserved, because without coal there could be no Great Britain. He went on to say that the use of coal in the raw state, which Siemens said was positively barbarous, required 4 lbs. to 4½ lbs. of coal to develop one horse-power-hour, and that we must do better than this, or the British people must do better, if they were to continue life as a nation. From the crude coal in the ordinary engine, requiring 4 lbs. to 4½ lbs. per horse-power-hour, to the adoption of the turbine engine, where it has been cut in half, is a great advance. Sir William says a still further advance is possible in the utilization of the fuel value in the gas-engine, whereby from 1 lb. to 1¼ lbs. of coal represented in the form of gas will do the same work. Now, we do not need to follow his argument in detail; yet it is very plain to see that, if you can multiply the value of 1 lb. by four, you can multiply by this number the length of time the coalfields will be available; and by these measures the coal supplies must be conserved. So that really his address was one along the lines of gas manufacture.

The third address is one with which gas men are probably more familiar, and it is that of Dr. William Bone, before the American Gas Institute at St. Louis, and repeated in New York on his way home. This related to the matter of surface combustion. It is in the line of Sir W. Ramsay's address, in that if a given heat quantity can be made to do another doubling of work, we have multiplied our original amount of coal in the raw state by two, then by two, and practically again by two.

Now, we cannot go into these details; but I wish to take up a phase of the gas business to-day which is only one of many that might be taken up along this line, to show that more and more of it, as in the case of any business that has to do with the fuel supply, is coming to be placed upon a scientific basis; and the scientific basis means simply that we know what we are doing. The original unit for reference, so far as the gas manufacturer was concerned, was, of course, the candle-power unit. Gas was originally made simply for its candle effect. A great deal of time, money, and energy has been spent on knowing what the candle power is. This was all very well when gas was of the simple type, and made in the same way, and burnt for its illuminating effect as a luminous flame. But with the multiplication of the types and uses of gas and the almost total abandonment of the luminous flame, the candle-power unit is a thing of the past. That is to say, it would be a thing of the past if the public knew as much about the gas business as the gas manufacturer does. I suppose, however, we shall have to wait on the public a little while before we are able to entirely abandon the candle-power unit. It will probably travel along hand-in-hand for a while with the other unit of which I wish to speak—viz., the heat unit for the measurement of quality and standard.

The point, then, before us is: "Shall we adopt or shall we make use of, or what is the use of, the heat-unit basis for our product?" Well, the consumer may not know it, but in the cooking-stove what he wants is heat, not light. He may not know it, but what is wanted in the gas-mantle is a gas which will make heat, because it is the heat generated in contact with the filament which makes the light; so that we shall get more light out of a high heat value than out of a low one. Again, the operator himself ought to know what he is sending out; for the reason that, under certain conditions, if he is supplying a gas which is lean and poor, it is just as much to his interest to know this fact. It should concern him just as much as the consumer, because there is going to be at some time a recognition of the fact that what is good for one is good for the other. Again, if he is sending out more heat units than are necessary, it is important for him to know it. As a gauge of his work, the heat-unit value is a better medium for determining this fact than anything else. It is far better than the candle-power unit.

With regard to the methods of measuring the heating value of gas, the common type of calorimeter with which we are most familiar is the Junkers. But it involves the metering of a rather large volume of gas in the first place, and the burning of that gas over cooling surfaces with a sufficient volume of air to carry on the combustion, and enough excess to make sure that the combustion is perfect. I do not wish to be understood as criticizing this calorimeter, but to bring out the points of difficulty that are met with in the instrument. In the first place, the metering of the gas by mechanical means is a rather difficult matter. Then barometric pressures are to be taken into account. So that the meter itself has quite a task in hand to give a correct measure of the quantity of gas being used. When it comes to the extraction of the heat, there are a good many difficulties involved in the burning of a gas which has a large percentage of hydrogen. The products are water vapour, which, spreading over a cooling surface condenses, and gives a wet surface for extracting the heat.

Efforts have been made to eliminate the difficulties of metering the gas (including the barometric error variation, and things of that sort) and the matter of radiation or carrying away of heat by vaporization of the moisture which results from condensation of the gas. The principle involved is as follows: We will burn two gases side by side in a dual instrument, and in one of these instruments we have a standard gas of known value and constant purity. Then we can compare our unknown gas with the standard gas under conditions which will eliminate matters of metering and radiation. That is to say, we have a volume of gas contained in a cylinder submerged in water, and another in a cylinder submerged in the same water. We have two equal volumes of gas under the same pressure and the same temperature. If we turn out the two volumes together, and one of them is known, then the other gas bears a direct proportion to that gas in its heat value. The other point I wish to establish is that the matter of radiation (or vaporizing) of water, or the change in heat values that may occur in the burning of the gas we are testing, may be eliminated in the same way. Supposing one side only generates 2° of heat and the other side 4°, the radiation from the latter will be twice as much as from the former. That is corrected in this way: The standard gas we will run on one side is hydrogen; and its value per cubic foot is 325 units. This 325 would be the heat developed by the hydrogen. What is the standard we are going to attempt? It is from 600 to 650 B.Th.U. On one side we are burning hydrogen, and the radiation error is not corrected, because we have twice as much on one side as on the other. But suppose we burn twice as much hydrogen on this side—two volumes of hydrogen against one volume of gas. In this

way we have discharged pretty nearly the same amount of heat under the two systems, and by so doing we have eliminated the error due to radiation. The two things then which are the greatest source of difficulty—the metering of the gas and the loss by radiation—would be overcome.

[Professor Parr showed views of the different parts of an improved form of calorimeter devised by him, and explained in detail the method of using it.]

I do not know that there are any other points which need to be demonstrated. It has taken nine minutes to burn out the gas. It takes perhaps five or six minutes to fill again, and take the reading of the thermometers; and perhaps another five or six minutes at the other end. So that 25 or 30 minutes would be ample to complete the cycle, as far as the time is concerned. If we are working on gas from outlying districts (a mile or two) the question might arise: "Would you like to take the instrument two miles out to the edge of town?" or how shall we get the flow of gas out at some distance where condensation and other changes have taken place? This matter, it seems to me, is simple, inasmuch as a gallon vessel of gas brought to the instrument is far easier; and this quantity would give two or three readings, since the holder only calls for a little more than 3 pints of gas. The particular thing in shipping gas is to have a tight container. But granted that you can ship gas in a container that will bring the gas intact without leakage, it is an exceedingly simple matter, instead of running in the gas from the main, to attach the hose of the container.

INDUSTRIAL VALUE OF LIGNITE.

Early last month, a paper on the subject of "Saskatchewan Fuels and Gas" was read before the Regina (Sask.) Society of Arts, Literature, and Science by Mr. R. O. Wynne-Roberts, M.Inst.C.E., who is known to many of our readers as a water engineer, and who is at present residing in Regina. As the paper was prepared for reading to a general audience, it was somewhat elementary in character. But portions were of special interest to makers and suppliers of gas, inasmuch as they furnished particulars in regard to the gas-producing properties of lignite; and these are given below.

In its raw state, lignite unfortunately contains about one-third its weight of water. So in cases where it has to be carried a long distance one-third of the freight charges are paid for what is not only a useless commodity, but one which is detrimental to its use. Many Saskatchewan lignites do not contain so much water. When exposed to the weather, lignite falls into fragments or slack, probably due to the evaporation of the moisture contained in it. But if it is stored in dry cellars, it not only slakes less badly, but improves in quality. The less moisture it contains, the better it is for heating. In the condition in which it is usually sold, therefore, it has two defects—viz., it contains too much moisture, and it slakes badly.

Briquette Manufacture.

Many experiments have been made to improve lignite for heating purposes—first by removing a portion of the water, and secondly by making it into blocks or briquettes. In Germany, for instance, lignite, or brown coal, has been made into briquettes with great success. It has been found that when this fuel contains about 30 per cent. of moisture and a suitable amount of tarry mixture, it will make excellent briquettes without the use of additional binding composition. Moisture has consequently some advantage in this respect. But in the process of manufacture two-thirds of the water is squeezed out; so that it contains only 10 per cent., which is about equal to ordinary coal. In Germany, a large proportion of the people use lignite briquettes as their principal domestic fuel; and the industry has grown to be immense. In the United States, experiments have been carried on by the Government, and it has been proved that briquettes can be made out of the poorest fuel; but each kind requires to be treated in a particular way. North Dakota lignite possesses similar qualities to those of Saskatchewan fuel; perhaps it is a little superior.

Experiments have been carried out to ascertain what can be made of lignites. The main reason why they are not found to answer in ordinary stoves or under steam-boilers is because the grates are not designed for the purpose. Lignite, besides containing water, has a low percentage of fixed carbon, and a high proportion of volatile matter; so that when it is used in ordinary grates it is found to be too flashy, and the draught is often too feeble. The development of briquette manufacture has been very great during the last few years. On the important coalfields of South Wales, Germany, and the United States, waste fuel amounting to millions of tons has been utilized in this manner, with profit to the capitalists and to the communities. The United States Bureau of Mines carried out a large number of experiments with lignites from Dakota and other States. Some samples were found to be incapable of being made into satisfactory briquettes without binding material; while others proved to be all that could be desired. The conclusions arrived at were that lignite ignited readily, made a hot fire, and burnt freely until it was consumed; little shaking or poking of the fire being necessary to obtain the maximum efficiency. The loss of unburnt fuel through the grate was from 6 to 8 per cent., which was not excessive, and could be reduced by using suitable grates. In these experiments, the lignite was crushed into pieces $\frac{3}{8}$-inch diameter or smaller. Dakota lignite was found to be tougher than the rest. It was then dried, and afterwards mixed and run into the pressing-machine. It is reported that lignite briquettes can be made for $1.50 per ton; but this does not include the cost of the fuel. Among the advantages to be obtained, it is stated that these briquettes give about 50 per cent. more heat, will stand handling, and will resist weathering much better than the raw fuel; and there would be a saving of about 20 per cent. on the freight charges.

Gas Production.

Lignite can be made into gas; and there are two ways of doing it—viz., by means of the ordinary gas-works plant, and also by producers. Professor Babcock, of the North Dakota University, carried out some interesting experiments in connection with this matter. He had a small plant, consisting of a retort-bench, condensers, scrubbers, washers, purifiers, and holder, constructed for the purpose of seeing what could be done with the material.

In an ordinary gas-works, the coal is placed in a fire-clay retort, which is heated to a temperature of about 2200° Fahr. When, however, Professor Babcock was experimenting with lignite, he found that it was not necessary to maintain so high a heat as this, but that 1200° to 1400° Fahr. would be ample. Less fuel is consequently required to fire the retort. The gas produced was purified by means of lime and other materials, and then it was passed into the holder for use. It was found that the unpurified gas had about two-thirds the value of good coal gas, but that when it was purified it was three-quarters as good. Tar and ammonia were also obtained, and about half-a-ton of coke. The gas burnt in an ordinary burner without smoking, and could be used like coal gas; but a greater quantity had to be consumed to get the same result. A ton of lignite yielded about 11,000 cubic feet of gas, which is about the same as with good gas coal. The coke obtained, however, was not suitable for use in its ordinary condition; so Professor Babcock made briquettes, by mixing pitch with it, and passing the mixture through a machine. These briquettes gave results equal to anthracite, which I consider excellent. I stated that gas could also be made by means of producers, of which there are three kinds—viz., suction, pressure, and down-draught types. With gas-producers, air is admitted, so the gas is not of the same quality as when it is made in ordinary gas-works plant. In the suction producer, after a fire has been kindled and the engine started, the suction of the engine causes enough gas to be generated as is required; but as lignite has not yet been used to any great extent, I will not longer dwell upon this class of producer. The pressure producer, as its name implies, is not dependent upon the engine for draught, but air is forced in. These producers are simply cylinders lined with fire-brick, into which air and steam are admitted in suitable quantities; and after the gas has been passed through scrubbers and washers to take out the tar, it is conveyed into a holder for use.

Many experiments have been made with lignite for making gas with this type of producer. A 250 H.P. producer was installed by the United States Bureau of Mines; and it will be interesting to note what was done. A 235 B.H.P. gas-engine was worked, and connected by belting to a 200 K.W. electric generator. North Dakota, Texas, California, and other lignites were tried, and a large number of ordinary coals. I will take for the purpose of comparison the results obtained with Pennsylvania coal. With Dakota lignite they experienced no difficulty in keeping up full load, and they found that the gas had a calorific value equal to about one-fourth that of ordinary gas—that is to say, from 145 to 164 B.Th.U. per cubic foot. Texas lignite was very satisfactory; and they found that the heat value was greater than that obtained from ordinary coal. The quantity of lignite used per electric horse power was as follows:—

North Dakota lignite	1·70 to 2·20 lbs.
Texas lignite	1·39 ,, 1 99 ,,
California lignite	2·06 ,,
Pennsylvania coal	1·01 ,, 1·50 ,,

The quantity of gas consumed per electric horse power was—

Dakota lignite	77 8 to 87·2 cub. ft.
Texas lignite	81·3 ,, 84·8 ,,
California lignite	87 7 ,,
Pennsylvania coal	81·5 to 103·4 ,,

The calorific value of the gas per pound of dry fuel was—

Dakota lignite	6470 to 7830 B.Th.U.
Texas lignite	7130 ,, 8100 ,,
Pennsylvania coal	8310 ,, 13,540 ,,

Generally speaking, lignite used by means of gas producers gave 2½ times the power it would if employed with steam boilers and engines. Furthermore, the experiments showed that low-grade North Dakota lignite developed as much power when converted into gas as did the best Virginia bituminous coal when utilized under steam-boilers.

Expressing the results in another way, the efficiency of the entire plant, based on the electric horse power made commercially available and the fuel consumed, was—

Dakota lignite	9·2 to 12·7 per cent.
Texas lignite	9·9 ,, 11·9 ,,
Ohio coal	11·1 ,, 14·3 ,,
Pennsylvania coal	10·8 ,, 15·0 ,,

So it will be seen that North Dakota lignite, which is a near relative

of Saskatchewan lignite, gave exceedingly good results when converted into producer gas.

On the basis of the tests carried out, it will be interesting to note the difference in the various gases made by producers and ordinary gas plant. Good bituminous coal will yield about 11,000 cubic feet of gas and about 1500 lbs. of coke, besides tar and ammonia; the calorific value of the gas being about 650 B.Th.U. per cubic foot. Ordinary bituminous coal converted into producer gas will yield about 120,000 cubic feet, with some tar and ammonia; the calorific value of the gas being about 150 B.Th.U. per cubic foot. Lignite will yield about 11,000 cubic feet of gas, some tar and ammonia, and half-a-ton of coke which can be made into briquettes; the calorific value of the gas being about 500 B.Th.U. Lignite converted into producer gas will yield about 70,000 cubic feet, with some tar and ammonia; the calorific value of the gas being about 160 B.Th.U. per cubic foot.

Some authorities are sanguine enough to state that in the near future producer gas will be supplied for all purposes at a rate that might seem to be incredible. Mr. D. B. Dowling, of the Canadian Geological Survey, in a paper read before the Canadian Mining Institute, said: "A town in the West supplied with lignite at from $3 to $4 per ton should have a producer-gas plant to use lignite, heat the houses with gas at 10 c. per 1000 cubic feet, use the gas-engine for electric lighting and water supply, and run all the factories by the same means of producing power." I am not at present in a position to express opinions on this phase of the subject; but that lignite can be used for various purposes cannot be gainsaid. Producer gas will require larger mains to carry it and larger fittings to consume it than ordinary coal gas; but when this matter is carefully gone into, it may be possible to find compensating factors.

In conclusion, what will be the advantage of using lignite in the various forms mentioned to-night? Cheap gas would constitute an excellent attraction to manufacturers, and it would also be a great convenience to our womenfolk. Lignite briquettes would be cheaper than any other form of fuel, and would be found satisfactory if proper grates were used. Lignite gas would reduce the smoke nuisance, and it would be handy for various industrial operations—such as annealing, japanning, soldering, brazing, drying, evaporating—and for use in stoves, boilers, bakers' ovens, &c. About 12 per cent. of the producers in the United States are operated with lignite. As natural gas cannot be duplicated by any known process, we should make the best possible use of our natural resources of fuel. The quantity of lignite mined in Saskatchewan appears to increase with the population. For instance, in 1891, with a population of 40,520, the lignite mined was 20,000 tons; in 1901, with a population of 90,564, the quantity was 44,900 tons; in 1906, with a population of 257,763, it was 170,582 tons; and last year, with a population of 500,000, it was about 200,000 tons. The Canadian Department of Mines estimates that there is in the Province enough lignite to last for 6000 years, with the present population using it at the rate of 10 tons per head per day.

The Sun as a Fog Producer.

Dr. John Aitken, F.R.S,, recently submitted to the Royal Society of Edinburgh a paper in which he described the results of observations made during the last four winters at Falkirk, where it had been noticed that fogs frequently began to form in the morning just at sunrise. They are valuable contributions to the question of the use for heating purposes of gas as compared with ordinary coal fires, and they indicate that the adoption of the more modern method may help at least to reduce, if not remove, the dense fogs so frequent in the vicinities of large cities. Dr. Aitken found that with a light wind bringing impure air—that is to say, air from densely inhabited areas—it would, when damp, form a fog immediately the sun shone, but that if there was no sunshine this did not occur. When, on the other hand, the wind came from a direction where pure air only was obtainable, the sun had no effect upon it. The conclusions arrived at were that the cause was attributable to sulphur from the coal-fires; and tests were made with the gaseous products of burning sulphur. These were found to be extremely unstable, and liable to be influenced by other causes and in various ways, making it change to the condition of solid or liquid particles, causing haze by floating in the air, and increasing in size owing to the affinity which some of these particles have for water vapour, which they condense into the air, increasing in size with consequent fog. It was found that the effect of light on such products was to change them in this way from the gaseous to the liquid condition. Direct sunlight effected this change in air which was pure from other contaminations, but could not do so when the light had passed through clouds, unless the other impurities from the combustion of coal were present. Clear coal-fires and coke-fires were found to act exactly like the products of burning sulphur. When, however, the products of combustion of ordinary household gas were tested under similar circumstances, it was found that they remained free from all particles which caused haze or fog, and that neither light nor any other influence had any effect on them.

The Manchester and District Junior Gas Association will hold their thirteenth annual meeting on Saturday, the 20th inst., at the Exchange Hotel, Fennel Street, Manchester. In addition to formal business, the proceedings will include the address of the incoming President.

DERWENT VALLEY WATER SCHEME.

Descriptive Lecture on the Works.

In previous issues of the "JOURNAL," reference has been made to the important scheme of water supply for Derby, Leicester, Nottingham, and Sheffield which about twelve years ago was entrusted to the Derwent Valley Water Board—a body composed of representatives of the Corporations of the towns concerned. The works are now approaching completion; and it is expected that the opening ceremony will be performed by the King and Queen in the coming summer. In view of the magnitude of the scheme, we give below some particulars of its engineering features, extracted from a lecture recently delivered by Mr. O. B. STEWARD, the Clerk to the Board, in the large theatre of the Nottingham University. It was illustrated by numerous photographic slides, two of which, by the courtesy of the Chairman of the Board—Sir Edward Fraser, D.C.L., who presided—we are able to reproduce. The Engineer of the scheme is Mr. Edward Sandeman, M.Inst.C.E., who was formerly Water Engineer to the Plymouth Corporation. It may be remembered that Mr. Sandeman is the President of the Institution of Water Engineers, and that, on taking office at the annual meeting at Buxton last May, he invited the members to visit the works, some particulars of which were given in the "JOURNAL" at the time, as well as in connection with the visit of the Manchester District Institution of Gas Engineers, two years previously.* The following is a more detailed description of the works.

After a few introductory remarks by Sir Edward Fraser, Mr. Steward proceeded with his lecture, in the preliminary portion of which he furnished some interesting particulars in regard to the Bills under which the statutory powers authorizing the formation of the Water Board were obtained, all of which have been given in our columns from time to time. He explained that the total reputed available yield of water by the scheme was 33·3 million gallons per day; and the apportionment, assuming that the local authorities concerned took daily all the water to which they were entitled, would be as follows: Leicester, 9·8 million gallons; Derby and Sheffield, 6·8 million gallons each; Nottingham, 3·9 million gallons; Derbyshire, 5 million gallons; and Nottinghamshire, 1 million gallons. The cost of the joint works will be borne by the Corporations in the ratio of their statutory proportions of water. The lecturer then passed on to deal with the engineering features of the scheme, with which our readers are more particularly interested.

THE ORIGINAL PLANS.

When the Derwent Valley Water Act of 1899 was obtained, there was no time to prepare new plans, and so the various works to be carried out were selected from the works provided for by the three Corporations of Derby, Leicester, and Sheffield. The original Derby scheme provided for three reservoirs, with earth embankments in Derwent Valley, two in Ashop Valley above Ashopton, one reservoir below the junction of the Derwent with the Ashop, one at Edale on the River Nol (another tributary of the Derwent), and one near Hathersage, on the Burbage Brook. The Leicester scheme provided for two reservoirs in Derwent Valley and one in Ashop Valley above Ashopton, all of which were to be constructed with stone dams, and one reservoir, with an earth embankment, below the junction of the Derwent and the Ashop. The Sheffield scheme provided for two reservoirs on the Derwent, with a tunnel to bring the water from the Ashop into one of them, and a reservoir below the junction of the Derwent and the Ashop. The Sheffield reservoirs, according to the Bill of the Corporation, were to have either earth embankments or stone dams; but as the latter were shown on the deposited plans (except in the case of the Bamford reservoir, which was to have an earth embankment 100 feet high), it was probable they were intended, especially as the height of the dam was in each case 129 feet. The reservoir common to all the scheme—the one below the junction of the Derwent and the Ashop—was in each case intended as a compensation reservoir. In the Act, power was obtained to make the dams either of masonry or of earth. The reservoirs to be constructed under the Board's original Act were six: Three (the Ronksley, the Howden, and the Derwent) from the Derby scheme, all in the Derwent Valley; another Derby reservoir—the Ashopton—immediately above the village of that name in Ashop Valley; the Leicester Hagglee reservoir, higher up the same valley; and the Sheffield compensation reservoir at Bamford. Powers were also given to make a railway with a view to constructing the works more cheaply, safely, and conveniently; the portion from Bamford to Ashopton being taken from the Leicester Bill, and that from Ashopton to Howden from the Derby Bill. The aqueduct was mainly on the lines of the aqueduct of the Leicester Bill. A period of ten years was allowed for the construction of the Ronksley and Howden reservoirs, and fifteen years for the construction of the Derwent reservoir. But the time for the Howden reservoir was by a later Act extended to fifteen years. The Act of 1899 further required that the Board should give a supply of at least 12 million gallons per day as soon as practicable. It likewise gave them power to capitalize interest for ten years, and postpone for the same period the commencement of payments into the sinking fund. The Board's

* See Vol. CVI., p. 513; and Vol. CXIV., p. 529.

policy from the beginning was to construct the works by instalments—a policy, in fact, suggested by the Act. The original intention was to make first the Ronksley and Howden reservoirs, to furnish the 12 million gallons daily mentioned in the Act.

Changes in Engineering Details.

In May, 1900, the Board appointed as their principal Engineer Mr. Edward Sandeman, who had then completed the construction of the Burrator reservoir on Dartmoor for the Corporation of Plymouth. He advised the Board to slightly alter the site of the authorized Derwent reservoir, by moving the Derwent dam about a quarter-of-a-mile higher up the valley, and increasing its height from 89 to 112 feet above the level of the river. By these alterations, as much water could be impounded in the Derwent reservoir as would have been impounded by the original Derwent and Ronksley reservoirs combined; and this would obviate the necessity of constructing the Ronksley reservoir. The Board adopted the suggestion; and the necessary amendment was made by an Act obtained in 1901. The reservoirs of the Board's first instalment then became the Howden and the Derwent, which would, it was estimated, give a daily supply of at least 13 million gallons. The Hagglee reservoir would be the only one in the second instalment; and the Ashopton and Bamford reservoirs would form parts of the third instalment. With the completed scheme, as the last-named reservoirs were too low to supply the towns, they would be used solely for storing compensation water, and the town supplies would be from the Howden, Derwent, and Hagglee reservoirs. The Board were bound to send down the river, in regular and constant flow, one-third of the estimated yield of the drainage area; this yield being ascertained by the results of rainfall observations, carried on, in the manner prescribed by the Act of 1899, during the six years 1900 to 1905 inclusive. So long as the scheme was not complete, provision would have to be made for giving compensation water from such reservoirs as might be existing at the time.

The Embankments Question.

The question of earth as against masonry embankments had also been considered; and the Board had decided that their dams should be of masonry. In the Bill for the Act of 1901, therefore, they sought to acquire power to make a railway from certain lands in the Lady Bower Valley, which by the Leicester Bill were to be taken for the purpose of quarrying stone, to join the railway authorized by the Act of 1899. When the Committee considered this Bill, there was considerable opposition to the granting of the power sought to make a railway from Lady Bower. This opposition, though mostly sentimental—the place being a beauty spot, and one of the favourite resorts of the people of Sheffield—was successful. Failing to get their railway, the Board decided not to go to the Lady Bower Valley at all for their stone; and ultimately they bought 52 acres of land on the hillside above the Midland Railway at Grindleford, quite close to the station. Here sidings were constructed in connection with the Midland Railway, and quarries were opened out high on the hill; the stone being loaded on the quarry face direct into the truck which was to be conveyed to the dam, and being brought down from the quarries to the Grindleford village—a drop of 300 feet—by means of an inclined railway, with a gradient of 3 to 1. The Board having placed the trucks on the Grindleford siding, the Midland Railway Company took them to the Bamford sidings, from which place the Board conveyed them to the dams.

Character of the Scheme.

The scheme of the Board was a gravitation scheme; the reservoirs being situate at levels sufficiently high to enable them to deliver water to all parts of the four cities or towns without pumping. The actual water-works could be divided into two parts—the storage reservoirs to hold the water, and the aqueduct to distribute it. It was evident that the storage reservoirs would take the longest time to construct; and so it was decided to commence these first, and to carry out all the work by administration. The Howden reservoir is 1¼ miles long, and is intended to hold 1886 million gallons; while the Derwent reservoir is 1¾ miles long and will hold 2000 million gallons. The dimensions of the masonry dams are:

	Howden Reservoir.	Derwent Reservoir.
Length	1080 feet	1110 feet.
Length between towers	500 ,,	600 ,,
Height from river level	117 ,,	114 ,,
Greatest thickness	176 ,,	170 ,,

The first thing undertaken in connection with the erection of the dams was the instalment of the cableways, which were erected by Messrs. J. M. Henderson and Co., of Aberdeen. There are two of them—the north and the south—at each dam; and the cables are suspended over the valley from timber towers fastened some distance up the hillside. The main cables are 7 inches in circumference, and they will carry a load of 6 tons. The largest spans are 1525 feet between the towers, with a sag of about 80 feet; and the height above the river is 150 feet. The idea of the cableways was to feed the cranes on the dams with stone and concrete during the process of building. The main excavations had to be carried down until a foundation was reached sufficiently strong to bear the enormous weight of the masonry. The greatest depth for the main excavations was 82 feet at Howden and 74 feet at Derwent. [After a description of geological "finds" during the progress of work, Mr. Steward described in some detail the process followed in the construction of the dams—the heel trench, the object of which was to prevent water percolating through the strata and passing underneath the base of the dam, forming a very important item in the construction.]

Construction of the Reservoirs.

When trial headings were made into the hills at the ends of the dams in the Derwent Valley, it was found that the hills were anything but water-tight. In the case of Howden, at a distance of about 600 feet into the heart of the hill, the ground was found to be quite dry (always a bad sign), and the rocks were extremely fissured—cracks 6 inches long being not at all uncommon. It was obvious, therefore, that though the dam might be quite capable in itself of holding back water, that water would mostly escape through the hills on each side; and steps had to be taken to prevent this. In the case of the Howden reservoir, the dip of the strata rose towards the surface, proceeding up to the reservoir; and so here a method was adopted similar to the heel trench. Long and narrow "wing" trenches were sunk from the top waterline, and carried up the valley from their junctions at the ends of the dam. They had, of course, to go down to water-tight strata on each side of the valley. This had meant sinking, at the point of junction with the dam on the east side, to a depth of no less than 192 feet. The water-tight stratum which was then found worked out to the surface just short of three-fifths of a mile up the valley; while a similar distance brought one to the end of the wing tunnel on the west side. The trenches are 5 feet wide, and are filled with concrete like the heel trench. At Derwent, owing to the dip of the strata, the wing trenches had to be constructed in a different manner.

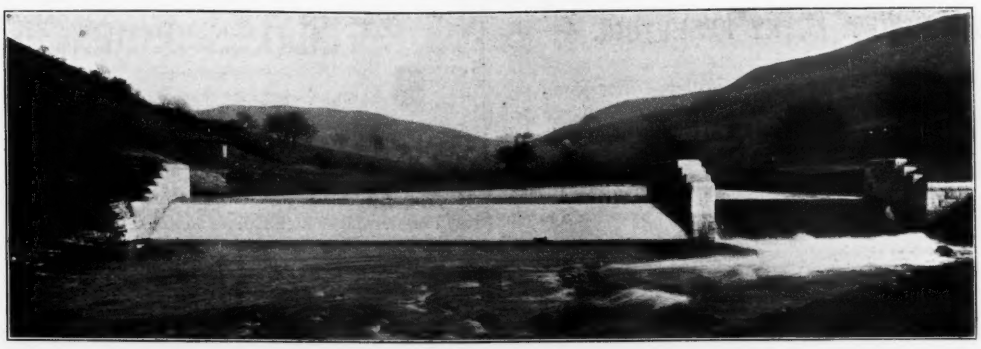
Out of each dam rise two towers; those on the east side having openings on the water face of the dam at varying heights, and also outlets at the base of the tower, on the down-stream side. Valves in the tower regulate the admission of water through the inlets, which are so placed as to enable the water to be taken at any level or from any depth beneath the surface; and it then passes through the outlets into the aqueduct. In ordinary practice, when the Howden reservoir is full, water will flow over the 500 feet of the crest of the dam between the towers into the Derwent reservoir; and the aqueduct will be supplied from this (the lower) reservoir. The towers on the west side of the dam contain the valves for regulating the flow of the compensation water which has to be given under the scheme.

The Distributing System.

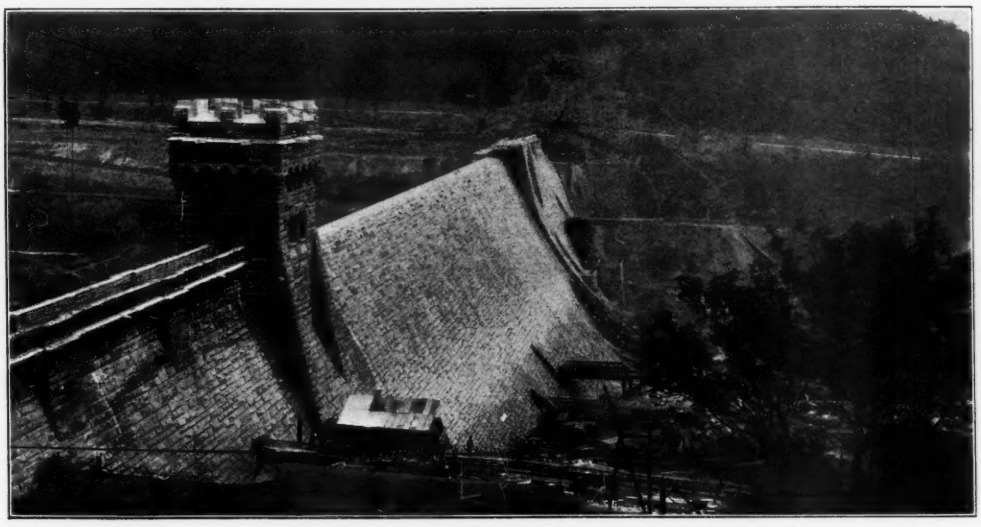
The distributing system consists of aqueduct works properly so-called, with filters at Bamford and a service reservoir at Ambergate. Sheffield's share of the water does not go so far as the filters; it being taken from the Board's main aqueduct at a point just south of Ashopton, and thence conveyed by a tunnel some 4½ miles in length into the existing works of the Sheffield Corporation in the Rivelin Valley. One main aqueduct extends from Derwent to Ambergate, with an extension from Howden, so that water can, if necessary, be supplied into the aqueduct direct from the Howden reservoir. The work below Derwent was carried out by contract, and was divided into five sections, which were let to five contractors. Where the aqueduct follows the contours, it is constructed on the "cut and cover" principle. Tunnels were driven as short cuts through hills; these being lined with a brick ring having a backing of concrete so as to fill up the spaces between the ring and the rock. The internal diameter of the tunnel and the "cut and cover" when finished will measure 6 ft. 3 in., and the amount of the fall is 15 inches to the mile. Pipes are used where valleys have to be crossed. The pipes of the main aqueduct are 45 inches diameter; and the pipe-lines south of the Ambergate reservoir are of different sizes from 40 inches down to 18 inches. They are all cast iron, except in a few places where the risk of damage in case of bursts would be especially great; and then steel pipes are used. A 45-inch pipe of medium thickness (1½ inches), and 12 feet long when laid, weighs about 3½ tons. The pipes are cast at the foundry with the socket end down, and are laid in trenches with the spigot end down hill, so that there is a minimum of 2 ft. 6 in. of cover between the top of the pipe and the restored surface of the ground. The joints are run solid with molten lead, except in the pipes of smaller diameter. The joints in pipes of less than 29 inches diameter are made with lead and yarn. The tunnels and the "cut and cover" work are constructed to carry the full quantity of water furnished by the complete scheme; but in the case of the pipe-lines, though the full width of easement has been purchased, only one line of pipes has been laid for the first instalment, and the other lines will be put down when the remaining instalments are carried out.

The Filtration Plant.

The filters, which have been constructed at Bamford, on the hillside, above Bamford Station, are of two kinds—one the ordinary sand filter, and the other the "roughing" filter. The floor of the filter is concreted all over, and covered with asphalt. In the roughing filters, which are the invention of M. Puech, only gravel is found. These filters, as their name indicates, are intended to do only the rough work of taking out of the water the larger and heavier matter; and they are used to save, first of all, a considerable area of sand filters, and secondly, the cost of cleansing the material. While the "roughing" filters were under construction, an ingenious method of cleaning them was patented by the owners of the "Filter" right and had been adopted by the Board. Lines of perforated pipes were laid under the ground, and connected with a blower worked by an oil-engine which



The Registering Weir at the Derwent Valley Water-Works.



The Dam Wall and Water Towers under Construction.

forced air through the pipes. The water in the filters is lowered to the level of the top of the gravel; and the air from the perforated pipes rises through the water and the gravel, bringing with it the dirt in the latter. The air-pipes are placed so as to distribute the air evenly over the whole bed of gravel; and when the air is forced through, it gives the appearance of the water boiling rapidly. By this method, the dirt is carried away without any turning over of the gravel. The water from the aqueduct can be passed either through the roughing filters without going through the sand filters, sent the reverse way, or passed direct into the clear-water reservoir without going through any filters at all. In the ordinary way of working, the water will be brought from the aqueduct, passed through the roughing filters, then into a distributing main, which is an open cut along the higher side of the sand filters, and thence through the sand filters into a collecting channel on the lower side. The filters are designed to deal with about 12 million gallons of water per day; the Sheffield share of the first instalment being taken from the aqueduct before the filters are reached.

From the filters the water is passed into a clear-water reservoir which holds about 5 million gallons, and which is used to equalize any variation in the rate of filtration. From this reservoir the water flows again into the aqueduct through regulating-tanks, when it is measured and delivered into the aqueduct in a constant and regular flow to the Ambergate reservoir. At Ambergate it is received into the reservoir, which has been designed in three sections for the three instalments; but only one section has been constructed at present. The proposed capacity of the complete Ambergate reservoir is 80 million gallons, while the actual capacity of the section now constructed is 28 million gallons. This reservoir is formed on a ledge cut into the hillside close to Crich, and above the Ambergate Station of the Midland Railway. It is a built-up reservoir, not like the storage reservoirs formed by damming a valley. The walls are 28 feet high, and the greatest thickness is 15 feet. As when the water reaches Ambergate it has been filtered, the reservoir there is covered in, owing to the rapid deterioration of filtered water when stored and exposed to the light. From the Ambergate reservoir run two lines of pipes. One goes to the east, taking Nottingham's supply to the county boundary at Langley Mill; and the other goes south with the supplies for Derby and Leicester. Derby's supply is taken from the pipe near Little Eaton, and then the pipe goes on to a point about a mile from the River Trent at Sawley. This is the end of the Board's works; those from Sawley to Leicester having been carried out by the Corporation.

The total length of the main aqueduct from Derwent to Ambergate is about 30 miles; tunnels accounting for 4 miles, "cut and cover" for 8½ miles, and pipes for 17½ miles. The distance from the Ambergate reservoir to Langley Mill is 8 miles, and from Ambergate to Sawley 16 miles; making with the short length from Howden to Derwent a total length of 56 miles of aqueduct constructed by the Board. There are many streams and some railway crossings; and all along the aqueduct will be found masonry valve-houses containing the valves for regulating and controlling the flow of the water. Automatic valves for cutting off the flow in case of burst pipes are also provided, with air-valves to prevent the collection of air inside the pipes, and consequent risk of burst from shock which bodies of air in the pipes may set up.

Rainfall Gaugings and Afforestation.

The works described include all those necessary for carrying out the purpose for which the Water Board was constituted; but others, of an interesting character, have also been undertaken—for instance, a method of ascertaining what the available rainfall has been by calculation made from the results of rain gaugings. This was done in the case of the Water Board; but, with a view to ascertain exactly what quantity of water flowed off the rainfall area, and so establish information which would be useful to the community in general, the Board constructed a weir on the Derwent, just above Bamford. This was a measuring weir, and had an automatic recording apparatus attached, so that the actual flow of water from the stream at any hour of the day is definitely arrived at. By means of this weir, in conjunction with the rain-gauges, the exact amount of rainfall in each year which had actually found its way down the river is ascertained. The Board have continued the rainfall observations since the termination of the compulsory period; and they have also undertaken a system of afforestation. Lands had to be purchased to form the sites of the reservoirs; but it was also necessary to acquire considerable areas above the top-water limits, in order to prevent any possible contamination of the water. These lands, with a total area of about 500 acres, including some spare land at the filters, are gradually being planted with forest trees suitable to the neighbourhood, and likely to prove remunerative to the future. Up to the present, about 140 acres have been planted; the trees principally used being larch, Scotch fir, oak, beech, and ash. The Board have their own nursery, where trees for planting are raised from seed, just below the Derwent dam.

The Outlay on the Scheme.

The authorized borrowing power of the Board is upwards of £6,000,000; and the actual expenditure up to the end of last month has been £3,265,000.

RELINING A LEAKY RESERVOIR.

The Bellevue reservoir of the Ohio Valley Water Company, which supplies a large suburban territory west of Pittsburg (Pa.), some time ago developed cracks through which the leakage is reported to have been at times as much as several hundred thousand gallons per day. The method of repair adopted, which has been described by Mr. Thomas Fleming in the "Cornell Civil Engineer," from which the following particulars have been taken, involved the placing of a thin lining of concrete inside the leaky brick walls, and giving the joints and inside surfaces special treatment. After the completion of the work, the reservoir was tested and reported to be watertight.

The reservoir was built in the shape of a cylinder, 130 feet in diameter and 20 feet deep, and consisted of an earth embankment with a vertical lining of brick masonry 2 feet thick, having mortar joints. It rests on a solid rock foundation, which several years ago was covered with a concrete floor. The capacity is 2 million gallons. In the summer season there was comparatively little leakage; but during the winter time the joints between the bricks developed a great number of very small cracks, and the loss of water through them amounted to about 400,000 gallons per day. The embankment around the walls appeared to be in good shape, and the leakage seemed to work down next to the walls to the shale formation below, and thence through seams to a neighbouring ravine. The water is pumped from drilled wells at a cost which made the loss from leakage about $1095 per annum.

The method of repair decided upon was to put a concrete lining 8 inches thick inside the brick walls. The lining was constructed in sections 29 feet long horizontally, and extending the full vertical height of the reservoir. These sections were connected by expansion joints made of 28 gauge sheet copper 12 inches wide and 20 feet long. The copper sheets were corrugated, and then folded at the centre for a width of 4 inches; one edge being inserted in the section first built, and the other placed in the adjoining section when ready, leaving the fold between the faces of the sections.

The specifications stated that the contractor must not cut holes in the floor for bracing or supporting form work. Heavy timbers were therefore laid across the floor, braced against the opposite walls, and form supports nailed to these main pieces. Forms for four sections were provided, so that the work of placing the concrete could proceed continuously. It took a day to pour one section, and during this time the carpenters were bracing the section for the next day's work, and the labourers were removing forms from sections poured two days before. The form for each section was made in a single piece. One-inch sheeting was nailed to 2 in. by 12 in. horizontal pieces cut to the arc of the circle and spaced 2 feet apart. Behind these 2 in. by 10 in. struts were placed vertically 5 feet on centre, and braced to the floor.

The concrete was a 1:2:4 mixture placed wet and thoroughly spaded; the filling being made slowly so that the concrete in the lower portion would attain its initial set before the pressure from above could cause change in the shape of the form. Sections were poured alternately, and each was allowed to stand two days before removing the form. The surface was then gone over with tools, imperfections were removed, and a thin coat of liquid cement grout applied. The work was completed in 24 days, which was the time specified in the contract; and the cost was $2000.

Natural Sources of Power.

In consequence of the attention drawn by Sir William Ramsay, at the fourth annual meeting of the British Science Guild, to the waste of the Empire's natural sources of energy, a Committee was appointed to consider the subject; and the Guild has lately issued a series of reports written by the members. Dr. G. T. Beilby reviews the conclusions of the Royal Commission on Coal Supplies, the final report of which was dated Dec. 28, 1901, and suggests that the Guild might usefully undertake the work of continuing the Commission's inquiry in some permanent way; keeping certain of the more important statistics up to date and reporting from time to time on progress in economy and reform. In discussing possible economies in the manufacture of coal gas and coke, Professor Vivian B. Lewes remarks that if carbonization of coal at the pit's mouth and distribution of the gas could be adopted, the perfect solution of the problem would be a combination of high and low temperature distillation plants to supply metallurgical coke and smokeless fuel; the poor coke-oven gas, enriched by the low temperature gas, yielding an ideal gas supply. But he fears that the interference with vested interests entailed by such a scheme would prevent its adoption. Mr. Dugald Clerk, in a report on the thermal efficiency of gas-engines, states that if steam power could be entirely replaced by power obtained by means of internal combustion, the consumption of fuel would be reduced to one-half. Sir Boverton Redwood discusses the present and prospective supplies of petroleum and shale oil available for power, and points out that if the whole of the crude petroleum produced in 1910 were employed as fuel for steam-raising, it would not replace much more than 5 per cent. of the world's output of coal; while if it were used in internal combustion engines, it would be equivalent as a source of power to about 15 per cent. of the coal. Other reports are in preparation.

CORRESPONDENCE.

[*We are not responsible for opinions expressed by Correspondents.*]

Professor Lewes's Smoke Abatement Lecture.

SIR,—Professor Lewes recommends a return to lower temperature carbonization for the purification of the air; but when coalite first came on the market, did not some of the most eminent gas engineers say that the use of such fuel on an extensive scale would introduce an element to the air worse, and much more destructive, than coal smoke. Lower carbonization will not destroy this sulphurous vapour.

Mr. Scott Moncrieff, again, in his lecture quoted the opinion of the Manager of the old Phœnix Gas Company in 1880, as follows: "The scheme is impracticable on account of the difficulty in drawing charges of partially coked fuel from the retorts, the excessive amount of smoke, and the effect the water used in quenching the hot discharge had in making it friable and of little value when obtained." This was the cause of the failure of the original "char oven;" and it evidently is the cause of the failure to-day—the most recent attempt on a practical scale having been abandoned.

None of these systems of lower carbonization are a remedy for the pollution of the air with sulphur vapours.

Mr. Scott Moncrieff mentioned an exhibit as "interesting in having introduced the well-known chemical action of gunpowder, in which the oxygen of the nitre combines with the carbon and sulphur. The progress of this invention will, no doubt, be followed with great interest."

The distinguished lecturer invited discussion on the process, and on the principle that an ounce of fact is more effectual than a pound of theory. In proof that this process eliminated the sulphurous vapour from coke carbonized to the highest possible temperature, I mentioned one of the largest hotel and restaurant proprietors in the kingdom and one of the largest fire and life insurance companies "on earth." The hotel and restaurant proprietors found they could use this fuel in their sitting rooms and bedrooms without having complaints about sulphurous fumes, and the grill cooks are delighted with it, as it does not give them sulphurous throats, as did also the engineer at the insurance company's buildings.

When in further support of these statements I mentioned the fact that the hotel and insurance companies paid 20 to 30 per cent. more for this fuel than they paid for ordinary coke made at the same gas-works, I was called to order, because I indicated "shop." But what better argument could be adduced in favour of anything than that it yields 20 to 30 per cent. more revenue, and that buyers were prepared to pay more money for it. "What is the good of an idea if it will not pay?"

Now as it has been abundantly proved that this process eliminates the volatile sulphur from coke, makes it free from clinker, and more easy to ignite (which will be a great boon to the public), it follows almost as certain as "day follows the night" that it will eliminate part if not all of the volatile sulphur from the "gas," which should be a great boon to the gas engineer and the gas industry. Technically the explanation is that the gas passing through the oxygen vapour ("gunpowder") referred to by Mr. Scott Moncrieff "transforms the sulphur in the gas into sulphuric acid, which, being soluble in water, is washed out of the coke when it is quenched." Mr. Kendrick, of Stretford, and others have proved by practical working extending over several months that it not only reduces the sulphur in the gas, but it also increases the yield of gas.

Another eminent gas engineer, after exhaustive tests, asserts definitely that it also increases the yield of ammonia considerably. This was proved in numerous trials with identically the same coal.

It has also been proved by these engineers that it ignites much more readily than ordinary coke; and in an anthracite stove in use at the exhibition it lasts all night. From 10 p.m., when the exhibition closes, it is well alight and there is a good fire at 10 o'clock next morning.

34, *Great Tower Street, E.C., March* 30, 1912. W. WINGATE.

PARLIAMENTARY INTELLIGENCE.

HOUSE OF COMMONS.

Down to Wednesday last, when the House rose for the Easter recess, which will terminate to-morrow, the only further progress made with Private Bills in which readers of the "JOURNAL" are interested was the reporting, with amendments, of the Belfast Water Bill.

The Lighting of the House.

The proposed change in the arrangements for lighting the House, to which reference has already been made [*ante*, p. 43], was the subject of further questions on Monday last week. Mr. Lynch asked the hon. member for St. George's-in-the-East (Mr. Benn), as representing the First Commissioner of Works, whether, in view of the fact that under certain conditions electric light was more fatiguing to the eyes than gaslight, and under other conditions might be preferable, he would be guided by expert advice in the installation of any new system in the House. Mr. Benn said the First Commissioner intended to take the opinion of an oculist on the subject; and until this had been done, the alteration in the lighting would not be proceeded with. Mr. Ormsby-Gore asked Mr. Benn whether he would appoint a Select Committee to inquire into the question of the best method of lighting the House before he made any alteration in the existing gas system. Mr. Benn replied that, if it was the wish of the House that a Select Committee should be appointed, the First Commissioner would be glad to accede to it. He was, however, consulting expert medical opinion on the question; and he (Mr. Benn) would suggest that the hon. member should defer any further action until the report had been laid before the House.

REGISTER OF PATENTS.

Time Mechanism for Operating Electric Switches, Gas Valves, &c.

REID, F. T., of Exeter.

No. 25,607; Nov. 4, 1910. Re-dated May 4, 1911.

This clockwork time-mechanism is intended for operating electric switches, more especially for high-tension circuits, for operating gas-valves, and for other purposes where it is required to effect a mechanical movement at determined intervals of time—such as when replacing one electricity meter for another on a double-tariff system of electric current supply.

The invention relates to the class of such mechanisms in which the clockwork timing device is provided with a dial carrying adjustable projections, cams, or the like adapted at determined intervals of time to engage and operate levers or arms to release a power-driven rotatable member of the switch, valve, or the like, by which it is closed or otherwise operated as required.

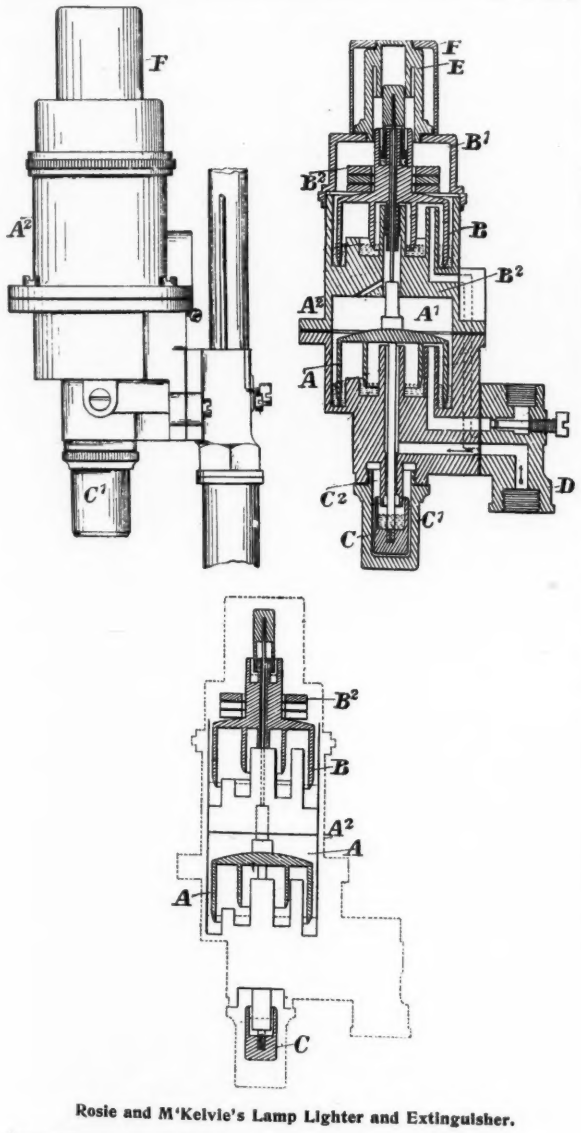
The levers controlling the intermittent rotation of the power-driven rotatable member of the switch or valve are arranged around the member in such manner that each end of the levers may alternately engage radial arms provided upon the member, so as to retain the latter in position until released by the cams of the timing device.

Actuating the Lighting and Extinguishing of Gas Lamps by Varying the Pressure in the Mains.

ROSIE, J., and M'KELVIE, J., of Edinburgh.

No. 5244; March 2, 1911.

This is a modification of patent No. 4283 of 1909, and consists in the means employed for actuating the lighting and extinguishing of gas lights by varying the pressure in the mains—essentially the co-acting of certain



Rosie and M'Kelvie's Lamp Lighter and Extinguisher.

duplex domes (preferably arranged one above the other) with a third upper dome or sealing cup, in such a manner that when the sealing cup, is in a restful position it is capable of maintaining a pressure of gas on the outer walls of the lower duplex dome, while when the sealing cup is elevated it is capable of allowing the dome to rise and gas to flow to the service pipe. The present improvements also provide for utilizing the usual increased pressure (above the ordinary lighting pressure) prior to the usual time for lighting up—that is to say, the appliance may be operated when a pressure of gas equal to (say) 36-10ths is available, while the ordinary lighting pressure is 30-10ths. When it is desired to light one circuit, the available gas pressure may have then diminished to (say) 33-10ths; but the apparatus is capable of effecting the lighting by diminishing the pressure.

The illustration shows a side elevation of the appliance, a longitudinal section in the position when the gas lights are extinguished, and a sectional elevation, with the outer casing shown in dotted lines and with the various bells or domes unsealed—except the pilot light cup, which is shown as sealing its connection.

A is an inverted bell or dome having within it a small inverted bell or dome. This duplex dome is sealed within the seals of the chamber A^1 of the casing A^2—that is to say, the duplex dome is provided with a separate chamber. The dome A effectually prevents gas from escaping from the inlet source by means of the seal; while the smaller bell of the duplex dome governs the admission of gas. Above the dome A is a duplex dome B with an inner bell—the dome working within the separate chamber B^1. Above the dome A is the cup seal accommodating an inverted cup, the lower lip of which is sealed in the cup. The dome B may be provided with weights B^2 to suit different working pressures and circumstances. Beneath the domes A and B (that is to say, at the lower extremity of the appliance) is the cup C, for sealing the pipe in connection with the pilot light.

The casing of the appliance is preferably cylindrical; and it may be provided with a bracket D, to the lower end of which is secured the gas supply pipe, in communication with the mains—having at the upper end the gas supply pipe to the burner, and also having the pilot gas-tube.

As demonstrating the working of the appliance, let it be assumed that gas has access to the pilot light port, so that the pilot light becomes lighted. To effect the lighting up, the gas passes to the interior of the bell B, but cannot effect the lifting of the dome A, so as to put the ports into communication, until the back-pressure has been relieved or d spelled from the chamber A^1. The gas is therefore increased in pressure until it is of sufficient pressure to lift the dome B. Now as the dome B is lifted, it carries upwardly with it the inverted cup, and, consequently, the pin of the cup is forced upwards until the gas can, and does, have access to the chamber A^1 (the dome being kept well sealed under pressure). Now by diminishing the pressure, the dome B falls until the air or gas above the dome A (in the chamber A^1) can pass out of the appliance, whereby the back-pressure is taken away from the dome A—it being then free to rise with the diminished pressure and allow the gas to pass to the port of the burner pipe. Simultaneously with the lifting of the dome A, the projection on it engages with the bottom of the rod of the cup; and in so doing it elevates the cup and pin, so that it causes the cam to assume a position in readiness to be in a position for falling. Now to extinguish the lights, the dome B is also consequently lifted, and presents its pin at the left-hand side of the free end of the leg of the cam in such a position that the cam is prevented from swinging and causing the pin to engage with the notch of the cam. By thus increasing the pressure and lifting the top dome B, the cup again becomes sealed and gas is free to pass to the chamber A^1, whereby the back-pressure in it is again restored and causes the bell A to fall by reason of its gravity. By this reduction in the pressure, the dome B falls; and the cup C of the pilot light arrangement having fallen, the apparatus is again presented as shown.

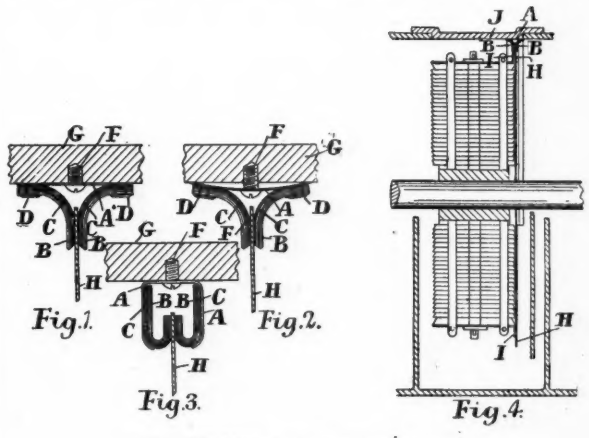
The pilot light arrangement is practically the same as in the earlier patent, and therefore does not need again describing.

Luting for Gas Apparatus, Valves, &c.

ROBERT CORT AND SON, LIMITED, and ROBINSON, C. P., of Reading.

No. 6610; March 16, 1911.

This luting for rotary washer-scrubbers, tar-filters, sluice-valves, &c., is said to be especially suitable for apparatus in which the luting is wholly or partially immersed in a liquid—thus providing for lubrication, which, although not absolutely necessary, may be desirable.



Cort and Robinson's Luting Arrangement.

Fig. 1 is a section through one form of the luting. Fig. 2 represents a section in which the elastic luting material is attached to a convex strip of metal or alloy. Fig. 3 shows a luting in which the elastic material is encased in a piece of metal or alloy of channel section.

Fig. 4 represents one form of the luting as applied to a rotary gas washer-scrubber.

A is the strip of metal referred to. B are strips of elastic material, such as cotton or flax belting, having chamfered or rounded edges. C is wire gauze made of anti-friction metal wire attached to, or made integral with, the elastic material. This material is secured to the strip by eyelets or rivets D, so that the wire gauze surfaces are in contact with each other (as shown) and press against each other—the pressure between the surfaces being dependent on the nature of the material and thickness of the strips.

The metal or alloy is secured to the apparatus by screws F at suitable intervals; a riveting tape being inserted between the strip A and the apparatus G to make a joint. H is a thin strip or tongue of metal or alloy inserted between the lips formed by the pieces of elastic material B to form the lute. If the piece to which the tongue is attached rotates, the tongue takes the form of a flat ring as in fig. 4.

The strip may be convex, as in fig. 2; so that as it is flattened when screwing-up the pressure between the meeting surfaces of the elastic material and the tongue will be increased.

As shown by fig. 3, the eyelets or rivets D and the strips E are dispensed with, and the elastic material B is inserted in a piece of metal or alloy A of channel section made trough-shape and closed into the form shown after inserting the strips B.

As shown by fig. 4, the tongue H takes the form of a flat ring secured to the rim I of the rotating sections of the apparatus; the strip A being secured to the casing J of the apparatus.

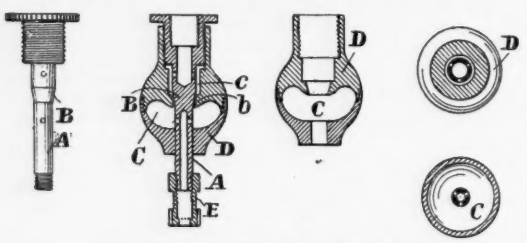
In the case of filters through which the liquid charged with tar is caused to pass, luting may be employed in order to make a tight joint between the outside of the receptacle and the casing of the apparatus, so as to allow the receptacle to be moved from its normal position for the renewal of the filtering media and reinstating in the normal position.

Inverted Incandescent Burners.

COVENTRY, W., of Pendleton.

No. 18,840; Aug. 22, 1911.

This modification of the invention described in patent No. 19,292 of 1910 is designed to provide for the flow of combustible mixture outwards from the inlet tube past the conical regulating valve into the expansion chamber and thence back again, through perforations, into the central tube, from which it is delivered to the burner-nozzle.



Coventry's Inverted Burner-Nozzles.

The burner is constructed (as shown) with a single injector in the form of a central plug or tube A forming the inlet and outlet passages for the combustible mixture, and also the conical regulating valve and a closed casing D, forming both the valve-seating and the expansion chamber for the gas. The plug comprises an inlet passage at one end, with lateral perforations above the valve, through which the gas flows outwards; a delivery passage at the other end, with lateral perforations below the valve, through which the gas flows inwards; and a conical valve B near the centre, for regulating the flow of the gas. The casing D comprises the valve-seating, a chamber into which the gas flows above the seating, and the expansion chamber C below the valve. The upper end of the casing D is screwed to receive the plug A. This and the valve B fit into the interior of the casing D, and pass through the expansion chamber C. The supply pipe connects to the inlet end of the plug, and the combustible mixture flows laterally outwards through the perforations and past the regulating valve B into the expansion chamber C, and thence laterally inwards, through the perforations and the central delivery passage, to the burner-nozzle E.

Incandescent Gas-Lamps.

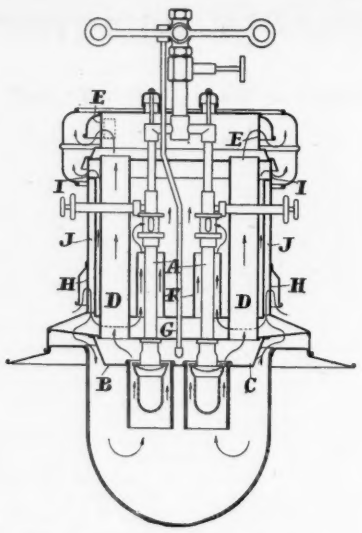
REISS, C., of Berlin.

No. 16,939; July 24, 1911.

This invention relates to lamps of the inverted burner type, in which air enters the lower part and circulates past the burner-tubes—part of the air mixing with the gas at the gas-nozzles, while the remainder escapes from the upper part of the lamp, the casing of which is surrounded by an insulating air jacket.

In the arrangement shown, beneath the gas-nozzle are arranged the burner-tubes A carrying the usual burners. The lamp is enclosed within an outer casing closed below by an internal reflector B and above by a cap. The gases enter the chamber C, into which open vertical tubes D, which terminate at their upper end in a chamber communicating with the atmosphere through apertures E provided with wind-guards. Surrounding each of the burner-tubes is a tube F, open at both ends; the lower end communicating with a space G, and thence with the outer atmosphere through apertures H in the outer casing.

Air for combustion enters the lamp by way of the apertures H, part of the air passing around the tubes D into the space G, while the remaining air passes into the globe and serves for creating combustion at the burners. The air in the space G, which has been primarily heated on its passage round the tubes D rises in the tubes F, and is then supplied to the mixing-chamber. The air not required in the mixing-chamber rises within the lamp, and escapes through the apertures I. It will thus be seen that the air is first preheated on its way to the



Reiss' Inverted Incandescent Lamp.

space G, and then serves to prevent excessive heating of the burner-tubes A, while the primary air is directed into close proximity to the mixing-chamber. The space, moreover, prevents excessive radiation of heat from the interior of the lamp, and thus serves to enable the heat from the hot gases in the tube D to be fully utilized in heating the primary air. It will also be seen that the gases rising in the tube D serve also to preheat the gas in the branch pipes in the upper part of the lamp.

LEGAL INTELLIGENCE.

ROBBERIES FROM PREPAYMENT METERS.

At the County of London Sessions last Tuesday, before Mr. R. Wallace, K.C., William Crawley was brought up on a charge of stealing money from a prepayment gas-meter, the property of the Commercial Gas Company.

Mr. HUNTLY JENKINS (instructed by Mr. G. H. Young), who prosecuted on behalf of the Company, said the prisoner was indicted for stealing 1s. 11d. from a prepayment gas-meter. The accused admitted that he had stolen the money, but said he had spent it for firing and bread, as he and his family were almost starving. He also told a detective that he had opened the lock of the meter with a piece of wire. At first the Magistrate before whom the accused was charged was prepared to accept his statement; and the case was remanded for inquiries to be made. The result was that a very different complexion was put on the matter, because the prisoner was an old offender—having been convicted on no less than six occasions on one of which he was sentenced to nineteen months' imprisonment for shop breaking. If prisoner's statement about himself and family starving had been true, the present prosecution might appear a little harsh on the part of the Company; but it was absolutely untrue. As a matter of fact, the accused was not starving, and a good deal had been done on his behalf. In connection with prepayment gas-meter robberies, it had been suggested, both in the Courts and in the Press, that gas companies ought to supply discs for use in these meters, instead of money. The matter had been carefully considered by the Directors of the Commercial Company, and they had come to the conclusion that there were many grave objections to this course. In the first place, there would have to be a reorganization of their staff; and he thought this might have been overlooked. Besides, it would not remedy this particular class of offence. The discs could very easily be imitated; and it would open up a field for making counterfeit discs, which would be as negotiable as money. People would have to go to tradespeople for the discs; and should the shops be closed, they might have to go a long way to the Company. These were only a few of the objections to the proposal; and they were insurmountable. In 1908, the number of robberies compared with the number of meters in use was 6⅛ per cent. The next year, however, they went down to 5 per cent.; the next to 4 per cent.; last year to 3 per cent.; and from Jan. 1 to March 23 this year they had been at the rate of 1½ per cent. per annum. The percentage of convictions had increased; but the robberies were less.

The JUDGE said he was very pleased to hear Counsel's observations, because of the great frequency of cases like the present at the past Sessions. He was also glad to hear the satisfactory figures given, for they indicated that there was a very rapid diminution year by year of these robberies in the East End. Of course, gas companies must be allowed to know something of their business. It had seemed to him the robberies might be avoided, and the great temptation in the way of indigent persons of easily taking money from the meters removed. Of course, one recognized the great convenience the meters were to the enormous number of people supplied. One would have been glad for some way to have been found that would diminish the temptation. But people must understand that they could not steal other people's property with impunity; and if they offended against the law, they must suffer the full penalty. In the present case, the prisoner had pleaded guilty to stealing the small sum of 1s. 11d. Had the amount been more, the sentence would have been much heavier; but as it was, he would have to go to prison for twelve months, with hard labour.

MISCELLANEOUS NEWS.

ALLIANCE AND DUBLIN CONSUMERS' GAS COMPANY.

The Half-Yearly General Meeting of the Company was held on the 30th ult., Alderman W. F. Cotton, M.P., D.L., in the chair.

The Secretary and Manager (Mr. Francis T. Cotton) read the notice convening the meeting, and submitted the report of the Directors, the principal figures in which were given in the "Journal" last week (p. 61).

The Chairman, in moving the adoption of the report, said the total gas and meter rental for the half year amounted to £132,531, or £5375 less than in the corresponding period of the year 1910. To this sum was to be added £22,556 received for residual products, &c., making the total revenue £155,279. The expenditure, including interest on debenture stock, &c., amounted to £117,768; leaving a balance of £37,511. From this a sum of £2000 had been written off the suspense account, leaving a balance of £35,511, to which was to be added £3541 carried from previous accounts; thus making a total of £39,057 available for distribution. The Directors recommended a dividend at the rate of 5 per cent. on the consolidated stock of the Company, payment of which would absorb £36,633; leaving a balance of £2524 to be carried to the next account. The abnormally high temperature coupled with the bright weather during the period under review, materially retarded the sale of gas. There was scarcely a gas company in the kingdom who were not more or less affected, more especially the London Companies. In the case of Dublin, it resulted in a loss to revenue of about 30 million cubic feet of gas. On the other hand, residuals produced an increase of £2427. Owing to the strikes which took place during the period under review, the greatest possible difficulties were experienced by the Directors in getting delivery of coals from some of their contractors. In fact, the present year had been most depressing, having regard to the state of the labour and coal markets. He was anxious to inform the proprietors that good results were being obtained at the Dublin station. This was largely due to the modern appliances which had been introduced at Brunswick Street. The make of gas per ton of coal carbonized during the half year equalled 12,100 cubic feet, although the plant was not yet complete. Since the beginning of the current six months, the make had risen to upwards of 12,300 cubic feet. At present all gas companies were passing through a crisis, owing to the greater cost of labour, coal, and other materials. The Directors feared there was every possibility of an increase in the price of coal, as the discontent among the coal masters and miners was almost certain to bring about such a result. So far as the Company were concerned, the Directors, in order to safeguard themselves, purchased a quantity of coal to augment the stock, so as to tide over the crisis, notwithstanding the fact that the price they were obliged to pay was nearly double that of the coals contracted for. No doubt the present trouble, coming after the threatened railway strike of last year, had caused great inconvenience to all manufacturers who were depending on coal for their fuel. These abnormal conditions might compel the Directors to increase the price of gas. During the half year there had been considerable increases and extensions of the principal mains mentioned in former statements, and also repairs and alterations to others. The expenditure thereon formed a considerable item in the half-year's expenses. The Directors were glad to state that the use of gas for cooking and heating purposes was rapidly becoming more general. That they were fostering this branch of the business might be seen by the following figures: During the half year there had been put in 1406 new installations, in each case fitted with cooker, brackets, and pendant. There were also 89 cookers fitted up in houses which were not supplied with gas beyond a service for the cooker; 685 cookers and 502 heating-stoves let on hire; and 16 cookers, 282 heating-stoves, and 24 gas-fires purchased and fitted up. Just now there were in use 33,278 free cookers, 104 slot cookers, 6090 hired cookers, 319 model cookers, and 6662 heating-stoves. With regard to gas-fires, they were coming into more favour every day, not only for their cleanliness, but also for their heating efficiency. In conclusion, he might inform the proprietors that the whole of the manufacturing and distributing plant had been kept in a state of efficiency.

The motion was carried unanimously, and the dividend recommended was declared.

GAS SUPPLY IN SHANGHAI LAST YEAR.

In the report presented by the Directors of the Shanghai Gas Company, Limited, at the annual general meeting, held on the 28th ult., they state that the business has continued to progress satisfactorily. The profits on the working account for the past year amounted to 321,455 taels—an increase of 41,490 taels compared with the year 1910; and the net profit was 288,013 taels, or 37,456 taels more than before. The balance at the credit of the profit and loss account was 219,497 taels; and the Directors recommended that it should be appropriated as follows: Final dividend (making 13 per cent. for the year), 84,000 taels; allowances for depreciation, 122,000 taels—leaving 13,497 taels to be carried forward. The quantity of gas sold to private consumers was 516,111,900 cubic feet—an increase of 11,347,900 cubic feet, or 2·24 per cent.; and 8,922,900 cubic feet were used for public lighting. The bulk of coal, &c., carbonized under the supervision of the Engineer-in-Chief, Mr. F. W. Potter, was 44,604 tons (33,706 tons 12 cwt. of coal and 435,889 gallons of liquid fuel); and the production of gas was 555,180,200 cubic feet, or at the rate of 12,446 cubic feet per ton. The gas sold was 525,034,800 cubic feet; used at works, unaccounted for, and in stock, 30,145,400 cubic feet; and unaccounted for in distribution, 4·07 per cent. New and enlarged mains to the extent of 8137 yards, or about 4·62 miles, were laid during the year—bringing up the approximate total length to 96·48 miles. The demand for tar showed a decided improvement last year; while the market for sulphate of ammonia remained satisfactory.

GLASGOW CORPORATION AND FREE GAS-FIRES.

As evidence of the popularity of the policy of the Gas Committee of the Corporation of Glasgow in urging the need of improved heating and lighting, it is shown in a statement prepared by Mr. Wilson that the cooking appliances hired for the first three weeks of March numbered no fewer than 6131, as compared with 657 for the corresponding period of last year. In view of this return, the Gas Committee have agreed to let out on simple hire gas-fires from and after June 1. Hitherto they have only been supplied by the Corporation on the hire-purchase system.

The recommendation the Gas Committee was not homologated by the Town Council without a good deal of heat and some opposition being displayed. The question came up at the meeting of the Corporation last Thursday, when a letter was read from the Secretary of the Glasgow and West of Scotland Ironmongers' Association objecting to the proposal to hire-out gas-fires. This, the letter stated, was in an entirely different position from the hiring of gas-cookers, as it was only in the better-class houses that these fires were to any extent used; and the occupants were well able to purchase them if they desired. The principle, it was contended, was an unwarrantable step in municipal trading, and a serious encroachment on the interests of private traders in the city, who paid heavy rates and taxes. Bailie Paxton, in moving approval of the minute, recalled that some time ago a progressive policy was instituted by the Gas Committee. They had many deputations from the Ironmongers' Association in objection to municipal trading. He did not know that he was one of those who favoured municipal trading, but he liked reasonableness in all things. He thought Glasgow citizens, having allowed the Corporation all these years to make gas, were equally entitled to allow them to sell it as best they could. The citizens had nearly £4,000,000 expended in the gas undertaking; and he submitted that the Corporation would not be doing their duty if they did not give citizens a reasonable return for their money. Eighteen months ago, it was agreed unanimously that all gas-fires should be let out on the hire-purchase system; and the present proposal was a second instalment of this policy. He went on to say that, with very few exceptions, none of the ironmongers stocked the appliances; and the reason for putting forward the proposal now was because of the approach of the removal term. Regarding the argument that gas-fires were used only by the rich, he thought the time had come when they should also distribute the comforts to the poor. He submitted they were bound to ignore the letter in consequence of what had happened years ago. The attitude of the ironmongers was that they would neither do the work themselves nor allow the Corporation to do it. The Corporation wanted to get on with their work.

The motion was seconded by Bailie Kirkland.

Mr. Guest moved that the matter be remitted back for further consideration; and Mr. Whitson seconded. Mr. MacNaughton, who supported the amendment, argued that the proposal, if adopted, would only result in an enormous annual loss to the Corporation.

The subsequent discussion was somewhat lively, and personalities were bandied about among the members. The storm eventually subsided; and on a vote being taken, the proposal of the Gas Committee was carried by 28 votes to 22.

COAL STRIKE AND GAS SUPPLY.

Further Measures to Economize Gas.

The unfortunate continuance of the unrest in the ranks of the mining industry, which has produced a condition of things unprecedented in the history of gas supply in this country, has necessitated the adoption of further measures to economize the gas which can be produced from the gradually decreasing stocks of coal.

Among the places suffering inconvenience through a shortage of gas, Birmingham stands out conspicuously. It will probably be remembered that the Gas Committee of the Corporation decided to restrict the supply of gas between certain hours, commencing on Monday, the 1st inst.; and an appeal was made to the consumers to refrain from using gas during the periods specified. It was found, however, that not only had the appeal been in vain, but that the consumption on Monday was actually greater. Very much the same thing occurred on Tuesday. The result was that on Wednesday morning the Committee announced that if the practice was continued, it would be necessary to take immediate steps to restrict the output of gas during the entire 24 hours of each day, as it was only possible to maintain an intermittent supply so long as consumers observed the temporary regulation of the department, and refrained from using gas between 1 p.m. and 7 p.m. It was officially stated that the position was a desperate one, for while small quantities of coal were coming to hand they were of no real help; and it was not unlikely that it would be a fortnight before reliable supplies were being received. On Wednesday, the Committee had a special meeting to review the situation, and decided that on Good Friday, and until further notice, the supply of gas would be discontinued between the hours of 4 a.m. and 11.30 a.m., and between 1.30 p.m. and 7 p.m. each day. This was a concession of three hours—two at midday and one in the evening; and it was highly appreciated by the citizens, and especially the poor. The Chairman of the Committee (Sir Hallewell Rogers) told representatives of the Press that the previous Monday was the first time for 36 years that there had been an intermittent supply of gas in the city. He added that the concession in the hours of supply was made in the interests of the citizens during the holidays; and he expressed the hope that they would all remember that the resources of the Gas Department were, unfortunately, limited at the present time.

Intimation was given by the Bury Corporation Gas Department early last week that from and including Good Friday, until further notice, the supply of gas would be cut off, excepting from 10.30 a.m. to 12.30 p.m., and from 7.30 p.m. to midnight. Several members protested against these hours; arguing that many workpeople cooked their dinners on returning from work. Ultimately, it was decided that

the supply be turned on at 11 a.m. until 1 o'clock, and from 7.30 p.m. to midnight. As mentioned in the "JOURNAL" a fortnight ago, the public lighting has already been restricted.

Notice was issued by the Directors of the Elsecar and Hoyland Gas Company last Wednesday that they would not be able to supply the consumers after the following day.

Concern was caused at Lancaster last Wednesday by an announcement that after noon on Friday gas would be cut off altogether except between 7 p.m. and 11 p.m. for lighting purposes; and that no gas would be available for cooking or motive power.

The Keighley Town Council recently decided, owing to the shortage of coal, to restrict the gas supply in the evening to six hours—from 5 p.m. to 11 p.m. At the meeting of the Council last Tuesday, Mr. Harrison, the Chairman of the Gas Committee, explained that the Committee, in consequence of representations that had been made to them, had decided to alter the hours; and that it had been arranged to turn on the gas from 7.30 a.m. to 8.30 a.m., from 11 a.m. to 1 p.m., and from 6 p.m. to 11 p.m. He said the consumption during the restricted hours of supply the previous day had been 30 per cent. more than was anticipated—probably due to the extensive use of gas-engines in the evening. Owing to the prolongation of the miners' strike, the Committee had been forced to buy extra coal "of a kind" to the extent of 500 tons; and this would enable them to go on for another fortnight, taking the previous consumption as a guide.

The position was regarded with great anxiety last week by the Gas Committee of the Leeds Corporation. It had only been found necessary to reduce the gas pressure from 1 p.m. to 6 p.m.; and it was hoped to maintain the service throughout the holidays. Mr. G. Ratcliffe, the Chairman of the Committee, stated on Wednesday that they would have to impose more drastic restrictions soon after the holidays, unless there was some rapid development in the direction of the miners getting back to work. Several lots of coal had been offered to the Committee; but the prices had been so high that nothing but a fear of the city being plunged into absolute darkness would tempt them to purchase.

The Walsall Corporation Gas Committee last week gave notice that, in consequence of the depletion of the stock of coal at the gas-works, it would be necessary, on and after Sunday the 7th inst., to shut off the supply of gas for all purposes between 5.30 a.m. and 11 a.m., and 1.30 p.m. and 6.30 p.m.

Among other places where it has been considered advisable to restrict the supply of gas to certain hours, and to curtail the public lighting, are Abergele, Bingley, Cheadle, Cleckheaton, Ripon, Sowerby Bridge, Stourbridge, and Thirsk.

The Great Demand for Coke.

The Manchester Gas Committee had before them at last Thursday's meeting a report prepared by the Superintendent (Mr. F. A. Price) as to the distribution of coke during the coal strike. This showed that the number of transactions in coke since the strike commenced to date had been 285,222—representing 4308 tons sold by the department. The Committee started with the sale of ½ cwts. at 3d. on March 7; but the demand being greater than the supply, the quantity was reduced on March 26 to quarter measures. Still the demand was greater than the supply; and as it was deemed desirable that more poor people should have the advantage of this cheap fuel, the Committee, on March 30, commenced to sell pennyworths of coke—the weight given varying from 14 to 18 lbs. This had proved a great boon to thousands of poor people. The first day, 20,234 pennyworths were sold; on the second, 31,100; and for the third day, the total was 29,144. It was also reported to the Gas Committee that there had been a great demand for small gas cooking-rings—over 1000 having been fixed in the preceding three days. There had likewise been numerous inquiries for gas-fires and gas cooking-stoves; the department having more orders to deal with than could be conveniently executed within the period named by the hirers and purchasers.

At Wednesday's meeting of the Oldham Town Council, Alderman Wilde (the Chairman of the Gas Committee) stated that no more coke could be supplied to the public from the works. They had, he said, supplied the fuel right up to the make, and were now compelled to stop the sale, as the coke being produced was required for the working of the water-gas plant.

At a meeting of the Rochdale Town Council last Thursday, Mr. J. Walker (the Chairman of the Gas and Electricity Committee) stated that, since March 14, no fewer than 21,973 half-hundredweights of coke had been sold at the gas-works. He added that there had been no perceptible economy in the use of gas by the public since the request was made by the Committee for more careful supervision.

GAS PROFITS IN AID OF RATES AT STOCKPORT.

An Increased Grant This Year.

The Stockport Town Council, at last Wednesday's meeting, approved of the estimates for the ensuing year; and these show that, despite larger contributions from the Gas Department and the Tramways' Committee, there is an increase in the municipal rate by 2d. in the pound—the total being 6s. 4d., as against 6s. 2d. last year. The past financial year has been a most successful one for the gas undertaking; and the Committee decided to allocate out of the profits £22,000 in aid of rates, which is £2900 more than was handed over last time. Last year the amount received from the trading departments (gas, electricity, and tramways) was £28,200; and this year the sum is £32,300.

Mr. Henry Bell (the Chairman of the Finance Committee) told the Council that, for the purpose of sound finance, the rates ought, in his opinion, to have been increased by 3d. last year. Next year he expected that, with the further requirements for water, they would want an additional £10,000; and the increase in the product of the rates was by no means in proportion to the rise in expenditure. He added that the Chairman of the Gas Committee, in announcing the increased grant from that department this year, assured him that the undertaking was perfectly sound, and that there need be no fear about the future. But, asked Mr. Bell, was it possible for the Gas Department to go on increasing its grant in relief of rates as had been the case this year? If not, the rates would, of course, have to be advanced.

Mr. W. H. Hollis voiced the views of the advocates of cheaper gas. He declared himself as strongly opposed to the Gas Committee handing over £22,000 out of profits for the relief of the rates. Was it fair, he asked, that the poorer class of consumers of gas should pay 2s. 6d. per 1000 cubic feet, when they were relieving the rates of people who had never spent a penny on gas or electricity in the town?

In reply to a question, Alderman Fernley (the Chairman of the Gas Committee) stated that they were going into the question of public lighting, and it was likely there would be a reduction in cost.

The estimates were adopted as submitted to the Council.

RECENT LABOUR TROUBLES IN MANCHESTER DISTRICT.

The Salford Town Council withdraw Offical Recognition of the Municipal Employees' Union.

At last Wednesday's meeting of the Salford Town Council, there was a brief but interesting discussion with reference to a resolution passed by the Lighting and Cleansing Committee, rescinding the agreement entered into in July of last year to "recognize the accredited representatives of the men's unions in relation to disputes," so far as the same related to the Municipal Employees' Union. This was a sequel to the recent abortive strike on the part of a section of the employees of the Corporation.

When the minutes of the Lighting and Cleansing Committee were submitted for confirmation, Mr. S. Delves asked for some explanation as to the passing of the resolution relating to the Municipal Employees' Union.

Alderman J. Hulton, the Chairman of the Committee, said the reason must be obvious to everybody. The Committee had been obliged to take this course, because the moment the Municipal Employees' Union was put on the same footing as the other trade unions, all discipline practically ceased in the Lighting and Cleansing Department. The state of things set up became intolerable; but since the official recognition of the Union had been withdrawn, the staff had worked together loyally, pleasantly, and amicably.

Mr. Delves thereupon moved that the resolution be referred back for further consideration. As an old trade unionist, he regretted the action taken by the Municipal Employees' Union in the recent dispute; but he thought it going a little too far to refuse to the Union recognition because a blunder had been made on the part of certain people. It was in his opinion one of the most unfortunate incidents that had for many years happened in connection with the labour movement in the district. He admitted that it was a grave mistake on the part of the men's Union to take the aggressive and militant action it did, before an opportunity had been afforded of discussing the men's alleged grievances. He thought, however, the mischief that had been done would be an object-lesson to the members and officials of the Municipal Employees' Union, and might lead them to adopt wiser measures in the future. He therefore asked the Council not to "slam the door" in the face of the association and declare that no official recognition would in future be given to the Municipal Employees' Union.

Alderman Hulton pointed out that in the event of the Municipal Employees' Union appointing different representatives, and making an application for recognition, the question would be re-opened.

Alderman Huddart, in supporting the action of the Committee, said that in consequence of the tactics of certain members of the men's Union, the department got into such a state that there was really no discipline.

Alderman Jackson, also speaking in support of the Committee, declared that the policy of the Municipal Employees' Union all along had been to set man against man and union against union. He went on to say that since 1906 the Trades Union Congress had condemned the methods of the Municipal Employees' Union as being detrimental to the trade union movement.

On the matter being put to the meeting, only the mover and seconder of the amendment to refer the matter back voted for it. The minutes of the Committee were thereupon confirmed by a large majority.

Shorter Hours for Salford Gas-Workers.

At the same meeting Alderman Phillips, the Chairman of the Gas Committee, made reference to a resolution passed by the Committee reducing the hours of labour of all workmen (other than tradesmen) at present working 54½ and 53 hours per week to 52 hours per week, and directing that the various rates at present paid for the former hours be applied to the 52-hour week. Alderman Phillips expressed the hope that this concession to the men would tend to increase the good feeling and the loyalty already existing among the employees of the department. The minutes of the Committee were confirmed.

The Concessions at Stockport.

The Stockport Town Council, at last Wednesday's meeting, confirmed the minutes of the Gas Committee dealing with additional concessions granted to the men. By the Committee's decision, the wages of labourers at present receiving 5⅜d. per hour, or more, are advanced ½d. an hour. The Committee could not see their way to increase the holidays, which at present are: For twelve months' men: Christmas Day, Good Friday, and two days at local "wakes;" and for six months' men, two of the above days. Full pay is granted with all holidays. Whenever possible, work will be found for the stokers when the retorts are shut down; and the Committee recommend that all men when leaving work should register at the Labour Exchange, in order that they may be accessible. The Committee are also of opinion that the stokers ought not to refuse their help in cases of breakdowns, which are very infrequent. Reduced shift pay is to be abolished.

The Directors of the Imperial Continental Gas Association recommend the declaration of a dividend of 4⅛ per cent. for the half year ended Dec. 31 last (less income-tax) on the £4,940,000 stock.

A BRISTOLIAN PIONEER IN GAS LIGHTING.

Establishment and Progress of the Bristol Gas Company.

In the "Bristol Times and Mirror," some articles have been appearing on "Bristol Men;" and the fifth of the series, which was given recently, was devoted to a pioneer of gas lighting in the city—one John Briellat, a dyer carrying on business in Broadmead, but subsequently the manager of the first gas company established in Bristol. His portrait now hangs on the walls of the present Company's offices. As he introduced gas lighting to his fellow-citizens before the illuminant was seen in London, a few extracts from the article may not be without interest.

It was in the year 1811 that Briellat astonished Bristolians by lighting his shop with gas; and their astonishment became amazement when he added gas-lamps in the street itself. The fact was that he had been in communication with Murdoch at Redruth, where he had seen in operation the process of gas manufacture. The first intimation of his mad proposal, as it was thought, was made through an announcement in the "Bristol Gazette" for Sept. 6, 1811, of his intention to exhibit the new light every evening for a short time at his house, accompanied by a descriptive lecture; the first display to take place next evening at seven o'clock. Up to this time Bristol, in common with London and other places, had relied first on candles and then on oil-lamps. Just eleven years before Briellat's lecture, the Corporation had definitely refused to pay more than £26 12s. for street lamps in the city; and for this sum they stipulated that the lamps should be fixed at certain specified places. For the rest of the lighting, the residents had to look to parochial authorities and to themselves. It was a rare thing at that time for a lamp to burn all night. By twelve o'clock, as a rule, the streets were in total darkness, and became unsafe for respectable people.

As for the lighting of the shops, before gas was introduced it was on a scale both small and dismal; but a good deal of the lighting of streets was from shops and private houses, until such an hour as the former closed and the residents retired to bed, which was pretty early. It was not until 1851 that the street lighting of Bristol was put upon a proper basis. Then, by Act of Parliament, the various powers with regard to sanitation, paving, lighting, and watching were taken from the different sets of Commissioners and parochial authorities, and vested in the Corporation. By this time gas had overcome all prejudice and superstitious dread. People had not found the "poor whales" making any protest; and no town had been blown bodily into the air.

In 1816, the Bristol Gas Company commenced operations under Briellat's guidance, though it had been hard work to raise the capital of £5000. A small gasholder was erected near Temple Back, and then the Court of Aldermen raised the serious objection that it was too near a gunpowder magazine. The Court was moved to allow the streets to be opened for the purpose of laying pipes, and by May, 1817, a few shops were lit by gas—the principal streets being similarly lighted the following December. The proprietors of the Commercial Rooms declined to pay £120 for gas, and went on with oil and candles for six or seven years—until 1825, in fact—though the expense was £20 a year more than the gas was to have cost.

In 1819, the Gas Company were so well established, in spite of the charge of 15s. per 1000 cubic feet, that the Directors obtained an Act of Incorporation, and increased their capital to £50,000. It would not be like Bristol if, when a good thing was doing well, a rival did not spring up. And so, in 1822, the Bristol and Clifton Oil-Gas Company was started, with £24,000 of capital. Oil gas cost the consumer 40s. per 1000 cubic feet; but the new Company said the illuminating power was four times greater than that of coal gas. The older Company declared this to be untrue; and brisk competition was started. But oil went up in price, no dividends were possible, and the new Company had to take to coal. Still the rivalry continued

GAS COMPANIES' STOCK AND SHARE LIST.

As might be expected, business last week on the Stock Exchange was not at high pressure. The week began with Jewish holidays, which repressed the energies of two out of the four days the markets were open; and on the last two days they were closed altogether by the holiday of the Christians. There was time for some amount of movement, however; and the period was not quite devoid of interest. The opening was quiet enough; but there was a good undertone—the factors productive of satisfaction being the rather favourable Budget anticipations, cheaper money, and a prospect of early resumption of work by the miners. Thus Government issues stood firmly, and Consols advanced by ¼. Home Rails were cheerful, in confidence that industrial peace was at hand, and prices rose; but the last figures were not the best of the day. Americans were very uneven. Tuesday was quieter. The tone was less cheerful; and it closed quite dull. Gilt-edged securities were passive; but Rails were less pleased with the apparent course of the ballot, and prices underwent some lowering. Americans were weak. On Wednesday, the general tendency was towards depression. Consols did not like the Chancellor's Budget—having hoped for better things for the Sinking Fund—and accordingly receded ⅜; and other of the choicest issues sympathized. Rails were very quiet; but wherever there was a change in value it was downward. Thursday opened pretty steady and with some amount of business; but it soon died away to an almost dead-calm. Many members went off early, and made a half-day of it. Government issues were still weak, and Consols fell another ⅛, closing at 78 to 78¼—a loss of ¼ in the week. The Exchange was closed on Friday and Saturday. In the Money Market, the tendency was very variable. At one time, rates looked like stiffening materially; but they relaxed before the close. Business in the Gas Market was naturally not very abundant; but it was at least an improvement upon the dead-slack of the week before. Another and a gratifying feature was that, quiet as things were, there was a very nice time, the outward visible sign of which was a fair array of advanced quotations. In Gaslight and Coke issues, the ordinary was dealt in at very steady figures; nothing being marked at less than 103, and several transactions touching 103½. In the secured issues, the maximum realized 85½, the preference 104, and the debenture 79 and 79½. South Metropolitan was moderately active and very firm, changing hands at 116¼ to 117½ (a rise of ¼); and the debenture made 79. In Commercials, the 4 per cent. marked from 108½ to 109 (a rise of ½), the 3½ per cent. from 104 to 104¼, and the debenture 75½ and 76. Among the Suburban and Provincial group, Brighton original fetched 219, and British debenture 95. In the Continental companies, Imperial was done at 188½ to 190, ditto debenture 89½ and 89⅝, Union 83½, ditto preference 135 (a rise of 1), and European 20 5/16. Among the undertakings of the remoter world, Bombay marked 6 7/16, Cape Town debenture 78½, Primitiva 7 13/16 and 7⅞, ditto preference from 5⅜ to 5 7/16, River Plate debenfure 95½, and San Paulo 11⅜.

Issue.	Share.	When ex-Dividend.	Dividend or Dividend & Bonus.	NAME.	Closing Prices.	Rise or Fall in Wk.	Yield upon Investment.
£			p.c.				£ s. d.
1,551,868	Stk.	Oct. 12	5	Alliance & Dublin Ord.	79—82	..	6 1 11
374,000	Stk.	Jan. 12	4	Do. 4 p.c. Deb.	91—93	..	4 6 0
250,000	5	Sept. 28	7½†	Bombay, Ltd.	6⅛—6⅜	..	5 13 2
50,000	10	Feb. 29	15	Bourne- } 10 p.c.	28½—29½	..	5 1 8
332,000	10		7	mouth Gas } B 7 p.c.	16—16½	..	4 4 10
75,000	10	"	6	and Water } Pref. 6 p.c.	14—14½	..	4 2 9
380,000	Stk.	"	13	Brentford Consolidated	258—263	..	4 18 10
330,000	"	"	10	Do. New	195—200	..	5 0 0
50,000	"	"	5	Do. 5 p.c. Pref.	118—120	..	4 3 4
206,250	"	Dec. 14	4	Do. 4 p.c. Deb.	97—99	..	4 0 10
219,055	Stk.	Feb. 29	11	Brighton & Hove Orig.	215—220	..	5 0 0
244,200	"	"	8	Do. A Ord. Stk.	156—159	..	5 0 8
490,000	20	Mar. 28	12½	British	45—46*	..	5 8 8
120,000	Stk.	Dec. 29	4	Do. 4 p.c. Deb. Stk.	93—95	..	4 4 3
109,000	"	Feb. 15	6	Bromley, A 5 p.c.	128—133	+2	4 10 3
165,700	"	"	4½	Do. B 3½ p.c.	98—101	..	4 9 1
82,278	"	"	5½	Do. C 5 p.c.	117—120	..	4 11 8
55,000	"	Dec. 29	3½	Do. 3½ p.c. Deb.	80—82	..	4 5 4
250,000	Stk.	"	4	Buenos Ayres 4 p.c. Deb.	95—97	..	4 2 6
100,000	10	"	—	Cape Town & Dis., Ltd.	2—3	..	—
100,000	10	—	—	Do. 4½ p.c. Pref.	4—5	..	—
100,000	Stk.	Dec. 29	4½	Do. 4½ p.c. Deb. Stk.	76—80	..	5 12 6
157,150	Stk.	Feb. 15	5	Chester 5 p.c. Ord.	110—112	..	4 9 3
1,513,280	Stk.	Feb. 29	5/9/4	Commercial 4 p.c. Stk.	108—110	+½	4 19 4
560,000	"	"	5½	Do. 3½ p.c. do.	103—105	..	5 1 6
475,000	"	Dec. 14	3	Do. 3 p.c. Deb. Stk.	75—77	..	3 17 11
800,000	Stk.	"	4	Continental Union, Ltd.	82—85	..	4 14 2
200,000	"	"	7	Do. 7 p.c. Pref.	134—136	+1	5 2 11
492,270	Stk.	—	5½	Derby Con. Stk.	122—124	..	4 8 9
55,000	"	—	4	Do. Deb. Stk.	104—105	..	3 16 2
840,150	10	Jan. 31	10	European, Ltd.	20—21	..	4 15 3
16,160,600	Stk.	Feb. 15	4/14/8	Gas- } 4 p.c. Ord.	102⅜—103¾	..	4 11 3
2,600,000	"	"	3½	light } 3½ p.c. max.	83½—85½	..	4 1 10
4,062,235	"	"	4	and } 4 p.c. Con. Pref.	102—104	..	3 16 11
4,531,705	"	Dec. 14	3	Coke } 3 p.c. Con. Deb.	79—81	..	3 14 1
258,740	Stk.	Mar. 14	5	Hastings & St. L. 3½ p.c.	93—95	..	5 5 3
82,500	"	"	6½	Do. do. 5 p.c.	—	..	—
70,000	10	Oct. 12	11	Hongkong & China, Ltd.	17—17½	..	6 5 9
131,000	Stk.	Mar. 14	7½	Ilford A and C	152—154	..	4 17 5
65,780	"	"	6	Do. B	123—125	..	4 16 0
65,500	"	Dec. 29	4	Do. 4 p.c. Deb.	92—94	..	4 5 1
4,940,000	Stk.	Nov. 10	9	Imperial Continental	188—191	..	4 14 3
1,235,000	Stk.	Feb. 15	3½	Do. 3½ p.c. Deb. Red.	88—90	..	3 17 9
200,242	Stk.	Mar. 14	6	Lea Bridge Ord. 5 p.c.	125—129	..	4 13 10
561,000	Stk.	Feb. 29	10	Liverpool United A.	220—222	..	4 10 8
718,100	"	"	7	Do. B.	159½—161½	..	4 6 5
306,083	"	Dec. 29	4	Do. Deb. Stk.	100—102	..	3 18 0
75,000	5	Dec. 14	6	Malta & Mediterranean	4¾—5	..	6 0 0
560,000	100	Apl. 1	5	Met. of } 5 p.c. Deb.	100—102*	+1½	4 18 3
250,000	100	"	4½	Melbourne } 4½ p.c. Deb.	100—102*	+1¼	4 8 0
541,920	20	Nov. 10	3½	Monte Video, Ltd.	12—12½	..	5 12 8
1,775,892	Stk.	Feb. 15	4⅜	Newc'tle&G'tesh'd Con.	99—101	..	4 6 7
529,705	Stk.	Dec. 29	3½	Do. 3½ p.c. Deb.	86—88	..	3 19 0
55,940	10	Feb. 29	7/7/0	North Middlesex 7 p.c.	14—15	..	4 18 1
800,000	Stk.	Dec. 14	8	Oriental, Ltd.	137—139	..	5 15 8
60,000	5	Mar. 14	8	Ottoman, Ltd.	7—7⅛	..	5 6 4
31,800	53	Feb. 29	13	Portsea Island A	137—140	..	4 18 9
60,000	50		13	Do. B	130—133	..	4 17 4
100,000	50	"	12	Do. C	127—130	..	4 12 6
398,490	5	Oct. 12	8	Primitiva Ord.	7⅜—7¾	+1/16	5 1 1
796,980	5	Dec. 29	5	Do. 5 p.c. Pref.	5⅛—5⅜	..	4 10 10
488,900	100	Dec. 1	4	Do. 4 p.c. Deb.	97—99	..	4 0 16
312,650	Stk.	Dec. 29	4	River Plate 4 p.c. Deb.	95—97	..	4 2 2
250,000	5	Sept. 28	12	San Paulo, Ltd.	11¼—11¾	..	5 2 0
115,000	10	"	6	Do. 6 p.c. Pref.	11¾—12	..	5 0 0
125,000	50	Jan. 2	5	Do. 5 p.c. Deb.	50—51	..	4 18 5
135,000	Stk.	Mar. 14	10	Sheffield A	235—237	..	4 4 9
209,984	"	"	10	Do. B	234—236	..	4 4 1
523,500	"	"	10	Do. C	234—235	..	4 5 4
90,000	10	Sept. 28	6	South African	8—9	..	6 13 0
6,429,895	Stk.	Feb. 15	5/9/4	South Met., 4 p.c. Ord.	115½—117½	+½	4 13 0
1,895,445	"	Jan. 12	8	Do. 3 p.c. Deb.	78—80	..	3 15 0
209,820	Stk.	Feb. 29	8½	South Shields Con. Stk.	156—158	..	5 7 7
605,000	Stk.	Feb. 15	5/16/8	S'th Suburb'n Ord. 5 p.c.	121—123	..	4 14 9
60,000	"	"	5	Do. 5 p.c. Pref.	117—120	..	4 3 4
117,058	"	Jan. 12	5	Do. 5 p.c. Deb. Stk.	119—121	..	4 2 8
502,310	Stk.	Nov. 10	5	Southampton Ord.	107—109	..	4 11 9
120,000	Stk.	Feb. 15	7½	Tottenham } A 5 p.c.	144—147	..	4 17 0
483,940	"	"	5⅝	and } B 3½ p.c.	114—116	..	4 17 0
149,470	"	Dec. 29	4	Edmonton } 4 p.c. Deb.	95—97	..	4 2 6
182,380	10	"	5	Tuscan, Ltd.	8⅜—8⅝	..	5 12 8
149,900	10	Jan. 2	5	Do. 5 p.c. Deb. Red.	99—101	..	4 19 0
236,476	Stk.	Feb. 29	5	Tynemouth, 5 p.c. max.	112—114	..	4 7 9
255,636	Stk.	"	6⅝	Wands- } B 3½ p.c.	141—144	..	4 15 6
85,766	"	Dec. 29	3	worth } 3 p.c. Deb. Stk.	71½—73½	..	4 1 8

Prices marked * are "Ex. div." † Next dividend will be at this rate.

until, in 1853, the two Companies were united. By 1878 the capital had grown to £550,000. There were then great developments; works being built at Stapleton Road, in addition to those in St. Philip's and Hotwells. The Company's paid-up capital now stands at £1,615,000. Briellat certainly built better than he knew.

Three methods of street lighting are now employed in the city—a few oil-lamps in thoroughfares recently brought within the boundaries; several hundred electric lamps provided by the Corporation; and 10,000 gas-lamps to which the Gas Company supply light. Street lighting now costs the Corporation upwards of £30,000 per annum—a marked increase on the £26 12s. of 1800.

WATER FROM COLLIERY WORKINGS FOR OLDHAM.

In the last number of the "JOURNAL" (p. 60), reference was made to a scheme which has just been completed for the supply of Oldham with water from the disused colliery workings of Messrs. Platt Bros. and Co., Limited. The following additional particulars are taken from an article on the scheme which appeared in the Engineering Supplement to "The Times" last Wednesday.

By an agreement made between the Corporation and the above-named Company, the water from the workings, which was previously pumped to waste, is delivered into a storage reservoir, whence it is conveyed into the existing mains. Two disused workings, known as Tunshill and Thistley Field, having a drainage area of 1176 acres, and estimated to yield a million gallons a day, are drawn upon for this purpose, and an additional area of 389 acres, known as the Ladyhouse workings, will become available in about two years. The water is collected in the workings, entirely separated from that derived from those now in use, and is conveyed by special works to a pump, which raises it to the surface, a height of 429 feet, and delivers it into the storage reservoir of the Corporation. Thence it is pumped into the Piethorne reservoir, an additional lift of 325 feet; the total lift thus being 754 feet.

The storage reservoir, which is entirely underground, has a maximum length of 111 feet, a maximum width of 58 feet, and a height of 11 ft. 2 in. from the floor to the soffit of the arched roof. When it is full, the depth of water is 9 ft. 6 in.; and its capacity is 225,261 gallons. It is constructed entirely in reinforced concrete, with floor and arched roof 6 inches thick, and side and internal walls 9 inches thick. The reservoir is divided into nine arched bays, each provided with the necessary ventilators—the arches being carried on 9-inch internal cross walls which are also arched; and an inlet channel, into which the water is delivered by 18-inch pipes laid from the colliery shaft, is provided at the end most remote from the suction wells. After the water has been delivered into the inlet channel, it is conveyed into the reservoir through a series of 6-inch pipes, and has to circulate through the whole length of the reservoir to the suction wells.

The pumping-station site adjoins the Butterworth Hall Colliery, and its area is 3600 square yards. The buildings consist of an engine-room, workshop, store and mess rooms, and lavatory. The engine-room, which is 60 feet long, 41 feet wide, and 19 ft. 6 in. high to the underside of the roof principals, has been arranged to accommodate the set of engines and pumps at present erected and a future extension. Steam at a pressure of 70 lbs. per square inch at the main stop-valve of the engines is supplied from the boilers of Messrs. Platt Bros. and Co. by a 5-inch steel pipe 150 feet long, laid on cast-iron roller carriers in a brick subway, 138 feet long, 3 feet wide, and 4 ft 6 in. high. The engines are of the horizontal cross-compound type, having cylinders 20 inches and 34 inches diameter, with a stroke of 2 ft. 6 in., and are arranged side by side on separate bed-plates. There is an Edwards vertical single-acting air-pump, 13 inches diameter, with a stroke of 12 inches.

The pumps, which have a capacity of a million gallons a day, are of the double-acting horizontal ram type, with working barrels 8 inches diameter and a stroke of 2 ft. 6 in.; the speed being 192 ft. 6 in. a minute. The valves, 64 in number, are of the multi-annular type. For each pump there are one vacuum and two air vessels. The suction-pipes from the reservoir to the condenser are 14 inches diameter, from the condenser to the pumps 10 inches, and from the pumps to the delivery-main 8 inches. The quantity of water pumped is measured by means of a Venturi meter fixed in the engine-room.

The water is taken from the pumping-station to the Piethorne reservoir in a delivery main, 12 inches diameter throughout, which, with the exception of two crossings over the Rochdale and Oldham branch of the Lancashire and Yorkshire Railway and one stream crossing, consists of cast-iron socket and spigot pipes. The main, which has a length of 4750 yards and a weight of 680 tons, of cast-iron pipes, is laid along the public roads except at the railway and stream crossings. The railway crossings consist of 12-inch steel tubes enclosed in water-tight steel troughs, 95 feet long, 1 ft. 8 in. wide, and 1 ft. 5 in. deep inside, supported on masonry piers built from the rail level to a height of 16 ft. 6 in. The stream crossings consist of 12-inch steel tube, 40 feet long, supported on masonry abutments. The main is divided into five sections, each controlled by reflux relief and bye-pass valves, and provided with the necessary wash-out valves and pipe-lines, and air-valves.

The estimated cost of the scheme, inclusive of land purchase and wayleaves, is £25,200. The engines and pumping machinery were supplied by Messrs. Ashton, Frost, and Co., Limited; the cast-iron pipes by Messrs. James Oakes and Co., of Alfreton; the steel tubes and troughs by Messrs. Clayton, Son, and Co., Limited, of Leeds.

The underground works at the colliery and the supply and laying of the delivery main to the storage reservoir were carried out by Messrs. Platt Bros. and Co.; and the pipe-laying from the pumping-station to the Piethorne reservoir, the masonry piers and abutments for the railway and stream crossings, and the inlet works at the Piethorne reservoir were executed by the Corporation's own workmen. The whole of the works were designed by, and carried out under the supervision of, the Corporation Water Engineer, Mr. C. J. Batley, M.Inst.C.E.

The CALEFACTOR

The Boiler WITHOUT Joints!

The Boiler and the Three-chamber Pre-heater are cast together in one piece.

Apart from the flow-and-return connections, and the cleaning arrangement, there are

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BIRMINGHAM.

Test the Calefactor.

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NOTES FROM SCOTLAND.

From Our Own Correspondent.

Saturday.

The period of anxiety for gas engineers and managers caused by the coal strike is not yet ended; and the only cheering factor in the situation is that, the ballot notwithstanding, a larger number of the Scotch miners are daily returning to work. It will be about a fortnight or three weeks yet—assuming that the miners decide to go back to work—before any considerable quantity of coal will be available at anything approaching the former normal prices; and until this condition of matters is reached there will not be a great improvement generally so far as the Scottish heating and lighting services are concerned. In this connection, it falls to be noted that the gas managers, without exception, where curtailments of services have been necessary have carried out their somewhat disagreeable duties in the circumstances with the minimum amount of public inconvenience.

During the week, the Glasgow Corporation have again been heavy purchasers; and at the gas-works it is reported that full supplies may be expected to the end of the coal strike. At Perth, rigid economy has been exercised, and the gas-works supply of coal is now expected to last until cheaper supplies are available. The report from Aberdeen is to the effect that the coal supply may see the end of the strike, while Dundee and Edinburgh can hold out for a considerable period. The Edinburgh and Leith Gas Commissioners have still to pay the railway company in coal for the engine for the transfer of supplies from the pithead "bing" to the Granton Gas-Works.

One of the grievances felt among the smaller burghs in Scotland is that the cost of stair gas-lighting is payable by the tenants, while in Edinburgh, Aberdeen, Glasgow, and Dundee—owing to special parliamentary powers—the cost is put upon the rates. At the meeting of the Convention of Royal Burghs in Edinburgh on Thursday, Bailie Hall, of Leith, proposed that steps should be taken to amend the Burgh Police Act, whereby the special statutory powers possessed by the larger cities would be universally enjoyed. By a large majority, however, it was decided to leave matters as at present.

The happiest results are being obtained from the series of demonstrations in cookery by means of gas appliances which have been promoted by the Edinburgh and Leith Corporations' Gas Commissioners. The indications are that the "forward" policy of the Commissioners will be splendidly justified. A large number of ladies and gentlemen met in the Gartshore Hall, George Street, last Tuesday, when a further exhibition and demonstration was opened by Councillor Inches. He remarked that the Gas Commissioners had for some time been considering that the consumption of gas had not been what it ought to be; and the decision to fit up gas-cookers in the houses of approved applicants was the result. They were following the example set by Glasgow, Dundee, and Aberdeen. He thought the demonstrations would prove to the most sceptical that cooking by gas was clean, tidy, and very economical. The demonstrations that had already been given in different parts of the city had been most successful, and he had been assured that orders for cookers had been coming in very rapidly. The Commissioners would do their best to supply these; but it might be some little time before they were able to meet all the customers' demands. The cookery demonstrations were under the direction of Miss M. J. H. Adams, the Principal of the Practical School of Cookery; and they were continued up to Thursday. Mr. Masterton, in moving a vote of thanks to Councillor Inches for opening the exhibition, referred to the utility, cleanliness, and convenience of gas for cooking.

At the meeting of the Glasgow Corporation on Thursday, Mr. Carson asked the Convener of the Gas Committee why gas benches were being put out at the Tradeston Gas-Works, and at the Provan Gas-Works the men were working overtime of twelve-hour shifts on Sunday for the purpose of supplying gas for the Tradeston district. Bailie Paxton explained that the stock of coal was running low, and they had to get the gas from somewhere. They were obtaining it from Provan.

The Buckhaven Town Council have now approved of the principle of a municipal gas scheme; and the Committee in charge of the matter are now to consult an expert.

At a meeting of the Water Committee of the Aberdeen Town Council last Tuesday, Mr. Stewart, the Convener, made a statement with regard to the recent visit to Aberdeen of Mr. Hogge, who has been appointed to advise on the proposals of the Water Engineer (Mr. Roberts) with regard to the River Dee. The Convener stated that Mr. Hogge had spent four days in the work of examination, and would pay another visit to the district, and that his final report would be ready by the middle of May.

The Dunfermline District Committee at their meeting on Tuesday reported that the cost of the Glenguey water-works had been exceeded by £5388, and that the sum of £6800 would be required to meet the cost of the puddle trench and other capital payments.

With reference to the statement at the end of the second paragraph of last week's "Notes," dealing with the position of gas undertakings in the present period of disturbance in the coal mining industry, that Broughty Ferry was in a pitiable plight, as the stock of coal was "nearing exhaustion," that the street-lamps were only lit at "distant intervals," and that the shopkeepers had been enjoined to close their premises rather than light up, Mr. George Keillor, the Corporation Gas Engineer and Manager, writes: "I would not like this statement to be handed down to posterity, because, as a matter of fact, we have not less than five weeks' stock on hand, and there is no fear whatever of the supply running out. As a business precaution, my Council ordered that only every second lamp should be lighted right through the period of the strike; and with this I agreed. The shopkeepers and the general public were also advised to economize in their own interest; but this was not done because we were short of coal."

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CURRENT SALES OF GAS PRODUCTS.

Sulphate of Ammonia. LIVERPOOL, *April* 4.

Notwithstanding the beginning of a new month and the approach of the holidays, the strength of the position of this article has continued unabated throughout the week, and all the present output has been keenly competed for at full prices. A good demand has been experienced from home consumers, and a fair inquiry has also come from abroad. The closing quotations are £14 17s. 6d. per ton f.o.b. Hull, £15 per ton f.o.b. Liverpool, and £15 2s. 6d. per ton f.o.b. Leith. The tone has become rather quieter for future delivery; but manufacturers maintain a very firm attitude, and refuse to make further sales over the second half of this year or for 1913 at less than £14 10s. per ton f.o.b. good ports.

Nitrate of Soda.

The market for this material remains unchanged, and spot parcels are firmly held for 11s. per cwt. for ordinary quality, and 11s. 1½d. for refined, *ex* store Liverpool.

LONDON, *April* 4.

Tar Products.

There is little alteration in the markets for tar products, though the prices on the whole continue firm. Business is practically at a standstill owing to the number of works that are closed; but one particular feature is the firmness of pitch. There has been a further slight advance; and the inquiry is good for both prompt and forward delivery. Benzols are firm, though new business is difficult to negotiate. Heavy and solvent naphthas are in good demand. Crude carbolic is practically at a standstill. Creosote remains firm.

The average values during the week were: Tar, 26s. 6d. to 30s. 6d. *ex* works. Pitch, London, 50s. to 50s. 6d.; east coast, 49s. 6d. to 50s.; west coast, Clyde 48s. 6d. to 49s., Manchester 48s. to 49s., Liverpool 49s. to 50s. Benzol, 90 per cent., naked, London, 11d. to 11¼d.; North, 10¼d. to 10⅜d.; 50-90 per cent., naked, London, 10d.; North, 9½d. Toluol, naked, London, 10d. to 10½d.; North, 9⅜d. to 10d. Crude naphtha, in bulk, London, 4½d. to 5d.; North, 3⅜d. to 4½d. Solvent naphtha, naked, London, 1s. to 1s. 0½d. f.o.b.; North, 10⅜d. to 11d. f.o.b. Heavy naphtha, naked, London, 11d. to 1s. f.o.b.; North, 10d. to 10½d. f.o.b. Creosote, in bulk, London, 2⅞d. to 3⅛d.; North, 2½d. to 2⅝d., salty, 2⅝d. to 2¾d., liquid. Heavy oils, in bulk, 3¼d. to 3⅜d. Carbolic acid, casks included, 60 per cent., east and west coast, 2s. 7d. Naphthalene, £4 10s. to £8 10s.; salts, 40s. to 45s., bags included. Anthracene, "A" quality, 1½d. to 1⅝d. per unit, packages included and delivered.

Sulphate of Ammonia.

There has been a further slight improvement in the market for this article during the past week; and with supplies being short, tender parcels have been eagerly competed for. Beckton to-day is quoted £14 5s. to £14 7s. 6d. Outside London makes are £14 2s. 6d.; Hull, £14 15s. to £14 17s. 6d.; Liverpool, £14 17s. 6d. to £15; Leith, £14 17s. 6d. to £15; Middlesbrough, £14 17s. 6d.

COAL TRADE REPORTS.

Northern Coal Trade.

There has been a little more disposition to do business in the Northern coal trade; but it was checked by the uncertainty that has been felt as to the time of resumption of work at the collieries. For small lots of coal, high prices have been quoted where such fuel was obtainable; and they have been supplemented by one or two cargoes which have been brought from Scotland. It is the belief that the collieries will generally resume in a few days; and thus prices are now named tentatively forward. For best Northumbrian steams about 18s. per ton f.o.b. is named; and for seconds, 17s. per ton. For gas coal, there is a strong demand; the contract quantities being large. For delivery a few days after resumption, about 16s. per ton f.o.b. has been paid for best Durham gas coals. It is probable that the demand for coal will be very keen after five weeks' stoppage; and it is also probable that the output will for some days be small, so that the prices may fluctuate for a time. There is, however, a plentiful supply of steamers at the coal ports; so that when fuel is brought down it should be rapidly got away. Coke is firm. Gas coke is being largely sold by most of the gas-works in small lots at moderate prices, and is very rapidly bought up; so that there are, practically speaking, no stocks at all.

Scotch Coal Trade.

The steadily growing number of miners going back to work throughout Scotland may be taken to indicate an eventual return to normal prices; but meantime trade in the coal market is practically non-existent. The few transactions there are, do not represent real values. On Thursday, bunker coal was quoted at 35s. per ton f.o.b. Glasgow, and best round dross at 25s. to 27s. 6d. per ton f.o.b.

New Issues of Gas and Water Capital.—It will be seen from our advertisement columns that Messrs. A. & W. Richards will offer for sale at the Mart, Tokenhouse Yard, E.C., next Tuesday, three new issues of capital by order of Directors. Offers will be invited for £8000 of 5 per cent. consolidated stock and £5300 of 4 per cent. perpetual debenture stock of the Uxbridge Gas Company; 1250 new ordinary 5 per cent. £10 shares in the Southend Water Company; and £3000 of ordinary "D" stock and £1000 of 4 per cent. perpetual debenture stock of the Broadstairs Gas Company.

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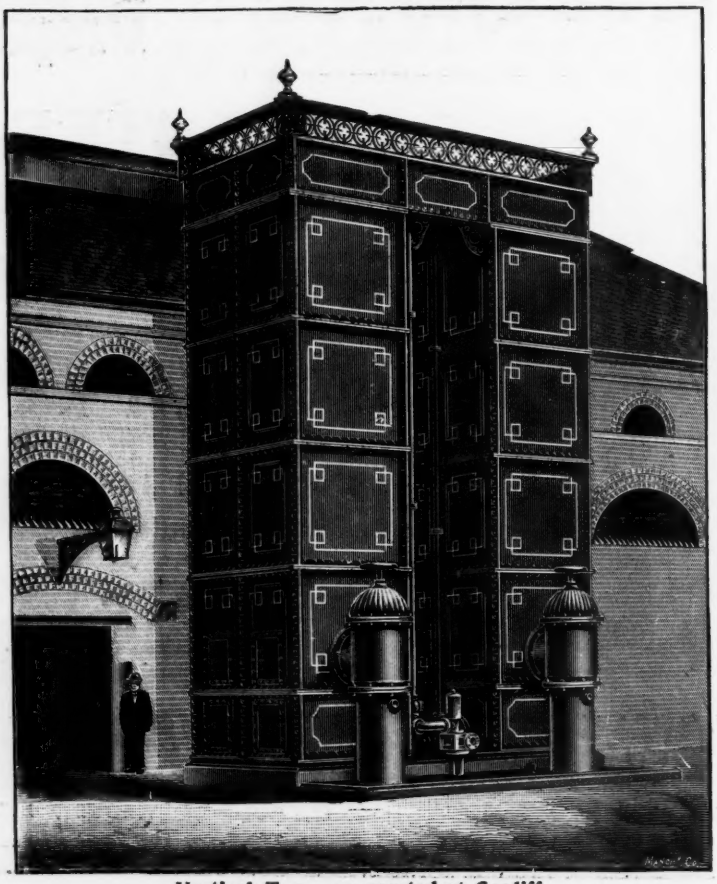

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EAST HULL,
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BRISTOL,
WALKER AND WALLSEND,
and other Works.

Stockton Gas-Workers' Wages.

At last week's meeting of the Stockton Town Council, the Mayor (Mr. M. Robinson), in moving the adoption of the minutes of the Gas Committee, stated that in January an advance of wages was granted to certain of the employees—amounting in the aggregate to £152 a year. The workmen, however, expressed their dissatisfaction at the advances proposed, on the ground that other gas workers had not been included. The Committee met a deputation of the men, along with Mr. Lynas, the Secretary of their Union. Each man's case was gone into, and all the objections that were raised by Mr. Lynas were duly noted by the Committee, with the result that they decided to ask the Council to grant the following advances: 3 coke enginemen, by 1s. 6d. per week; 3 men bullering pipes, from 6d. per hour to 6½d. per hour; 3 retort-scurfers, 6½d. per hour all round; 7 gas-fitters' labourers and 24 yard labourers, from 25s. to 25s. 6d. per week; 2 smiths' strikers, 25s. to 26s. per week; 4 street mainlayers, (1) 34s. to 35s., (1) 32s. to 33s., (2) 30s. to 31s. per week; 8 street mainlayers' labourers, 6d. per week; 2 horsemen, from 25s. to 25s. 6d. per week. These advances amounted to £154; making a total advance of workmen's wages of £306. With regard to holidays, it had been disputed whether they cost the Corporation anything at all. They did; they cost £290. Mr. Mitchell suggested that the matter should be referred back for further consideration; and an amendment to this effect was seconded by Mr. Morris, and lost. A further amendment by Mr. R. F. Brittain, to the effect that the further consideration of the question of low-paid men be referred to Committee, was carried.

Wickham Market Gas-Works under New Management.

As from the 1st inst., the gas-works at Wickham Market will be under new management; the property of the Gas Company having been purchased by Mr. Worthington Church, who owns many works in Essex and Suffolk. It is his intention to bring the works thoroughly up-to-date, and to offer a good and efficient supply of gas at a reasonable price. When a few necessary alterations have been completed, gas cooking-stoves will be let on hire at low rentals; and an exhibition is to be held to demonstrate the advantages of cooking by gas and the general use of gas apparatus. Under certain conditions, houses will also be fitted free of charge with three lights and a boiling-stove; the gas being paid for through a prepayment meter. The number of consumers and the consumption of gas in proportion to the population in Wickham Market are very low in comparison with towns of similar size; and it is trusted that, under the new management, the public will recognize the fact that the larger the business done the cheaper the gas can be made and the lower will be its price to the consumer. The present price of gas is 6s. 8d. per 1000 cubic feet; and, as a commencement, it will be reduced from the 1st inst. to 5s. 6d. for ordinary lighting purposes. It is hoped that this concession will induce a larger number of inhabitants to use gas, and enable the existing consumers to further extend its use.

Gas Supply in Sydney (N.S.W.) Suburbs.—The North Shore (Sydney) Gas Company had a net profit of £9394 for the six months ended the 31st of December last. Adding the £344 brought forward, there was £9738 available for distribution. The Directors recommended the declaration of a dividend at the rate of 4 per cent. for the half year, absorbing £7497, with a bonus of 1 per cent., amounting to £1873; leaving £368 to be carried forward. The dividend for the entire year was 10 per cent., including the bonus of 1 per cent. for the half year. The Gas Company supplying Manly, a town rather farther removed from Sydney than the one just referred to, had, at their annual meeting, a sum, with the amount brought forward, of £2333 for distribution. A dividend of 5 per cent. for the second half of the year was declared, £300 was added to the reserve fund, and the balance was carried forward.

APPLICATIONS FOR LETTERS PATENT.

7202.—Gibbons, G. B. A., and Masters, R., "Continuous annealing mufflers. March 25.
7203.—Gibbons, G. B. A., and Masters, R., "Furnaces for heating copper, &c." March 25.
7229.—Rotherham, H., and Johnson, W., "Stop-cocks." March 25.
7267.—Klusmeyer, F., and Mayer, L., "Gas-producers." March 25.
7283.—Calvo, J. M. B., "Acetylene generators." March 25.
7284.—Benson, H. S., "Thermostats." March 25.
7310.—Sparks, E., "Incandescent gas-lamps." March 26.
7327.—Wild, B. & R. O., "Gas-producers." March 26.
7393.—Dalén, G., "Incandescent lighting." March 26.
7447.—Schoeler, W., "Gas-valves." March 27.
7459.—Evans, E. W., "Carburetted air gas." March 27.
7476.—Anderson, D., "Gas-lamps." March 27.
7545.—Blake Bros., Ltd., and Boughton, E. M. W., "Taps and valves." March 28.
7562.—Inglis, T. S., "Automatic supply of gas." March 28.
7564.—Lindsay, R., "Stop valves." March 28.
7663.—Siemens-Schuckertwerke G. m. b. H., "Pumps for gases." March 29.
7688.—Potter, W. G., "Gas-making apparatus." March 29.
7712.—Matlack, A. F., "Gas-producers" March 29.
7720.—Valentine, H. S., "Atmospheric burners." March 30.
7739.—Malpas, A. E., "Gas-producer." March 30.
7758.—Gardiner, C. A. P., "Opening and closing valves," March 30.
7763.—M'Crea, D. F.. "Preventing the total deflation of inflated articles by reason of a leak in a part thereof." March 30.
7765.—Kent, W. G., and Hodgson, J. L., "Gas-meters." March 30.

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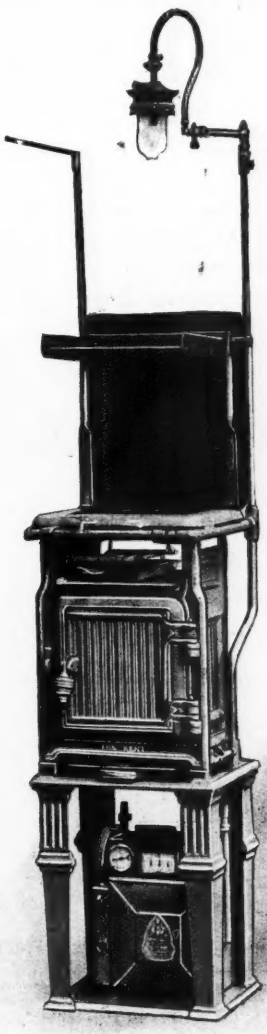

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Sale of Havant Gas Shares.—The Havant Gas Company obtained, at a recent sale by auction, a premium of upwards of £600 in a sale at Portsmouth of additional capital to the amount of £1500, bearing 7 per cent. dividend. Messrs. Penney and Clark quickly disposed of the sixty lots, each of five shares, into which the capital was divided, at from £7 to £7 2s. 6d. per share.

Felixstowe Public Lighting.—The Finance Committee reported at the monthly meeting of the Felixstowe Urban District Council that, in accordance with the authority of the Council in committee, they had engaged Mr. Reginald J. Wallis-Jones, of Westminster, to draw up a specification for public lighting, which should be impartial as between different kinds of illuminants. In answer to a question, it was stated that the fee was thirty guineas and expenses. Mr. Woodmancy said he was particularly pleased with the decision of the Council, because it was always thrown about that Mr. Ward and himself, as Directors of the Gas Company, wanted to keep the contracts with the Company. The report was adopted.

Metropolitan Water Board and Workmen's Compensation.—The experience of the insurance offices as to the Workmen's Compensation Act has been vastly different from, and much less satisfactory than, that of the Metropolitan Water Board. The Board is its own insurer; and up to the present time its contribution to a compensation fund has been fixed at 9s. per cent. per annum of the salaries and wages paid. So far the receipts have totalled £6103; and the compensation has only aggregated £1325. For the past three years the two sets of figures show an average payment of £370, and an average contribution of £1635. In the circumstances, the contribution for the future is to be reduced to 2s. 6d. per cent. of the salaries. Perhaps the explanation is that the risks run in this work are not very serious.

Gas Profits at Lincoln.—Addressing the members of the Lincoln City Council, Alderman Wallis (the Chairman of the Gas Committee) stated that the gross profit of the undertaking for the year was £14,183, against £14,681 last year. They brought forward £2368—making a total of £16,551. They had had to pay out for interest and sinking fund £7712, which left a balance of £8839; so the Committee were justified in recommending the grant of £7000 in aid of the rates. This was the largest amount they had ever handed over. Last year they gave £5000.

Holsworthy Gas and Electricity Company.—The second annual meeting of the Holsworthy Gas and Electric Supply Company, Limited, was held on the 29th ult. In the absence of Mr. W. H. Kivell (the Chairman), Mr. J. M'T. Dickson presided; and he informed the shareholders that both branches of the undertaking showed steady growth. The gas portion was the Company's chief asset; and on it there was a profit of £388, compared with £331 before. To encourage the use of gas-cookers, the price of gas for this purpose had been reduced from 5s. to 4s. per 1000 cubic feet. The balance showed that the step had been fully justified. The quantity of gas consumed was 2,601,700 cubic feet—an increase of 295,000 cubic feet. A dividend of 4 per cent. was declared.

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WANTED, FOR SALE, CONTRACTS, &c., ADVERTISEMENTS IN THIS WEEK'S "JOURNAL."

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